THE EAST AFRICAN AGRICULTURAL JOURNAL

of

KENYA
TANGANYIKA
UGANDA AND
ZANZIBAR

Vol. VII—No. 2

OCTOBER
1941

Price
Sh. 1/25

IN THIS ISSUE:

THE EAST AFRICAN AGRICULTURAL JOURNAL

Vol. VII **OCTOBER, 1941** **No. 2**

Subscription Sh. 5 per volume, or Sh. 1/25 per copy, post free, payable through any Agricultural Officer, or to the Government Printer, P.O. Box 128, Nairobi, to whom all business communications should be addressed. (Subscribers are advised to remit postal orders in payment, otherwise bank commission must be added in the case of cheques.) Editorial correspondence should be addressed to the Editor, Amani, via Tanga, Tanganyika Territory.

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Readers are reminded that all agricultural inquiries, whether they relate to articles in the Journal or not, should be addressed to the local Director of Agriculture, and not to Amani.

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THE EAST AFRICAN AGRICULTURAL JOURNAL

Issued under the Authority of the East African Governors' Conference and published every three months—July, October, January, April. Volume consists of four issues (commencing July issue).

Editor: Director, East African Agricultural Research Station, Amani.

Editorial Board: Directors of Agriculture, Kenya, Tanganyika, Uganda, and Zanzibar.

Assistant Editors: R. E. Moreau, Amani; Mrs. Holmes Jackson, Department of Agriculture, Nairobi.

FOREWORD

To dwellers in the tropics the short life of cut timber is a perennial curse, and buildings dependent upon wood are notoriously impermanent. Hard experience has taught the African a good deal about the relative durability of the various species of trees from which he derives his hut poles, but the information he has acquired has neither been recorded nor confirmed by controlled experiments. The relative durability of sawn timbers, a subject which from the European point of view is even more important, is also most imperfectly known.

Phosphatic manuring of wheat is dealt with in a highly practical article by Mr. Gethin Jones. His recommendations are based on both laboratory work and a knowledge of the soils of the different districts of Kenya. The subject is a complicated one because not merely the amount of mineral nutrients in the soil, but also their availability, needs to be known. The choice of phosphatic fertilizer depends on its characters and its cost; and moreover on whether immediate returns to meet war demands are the prime consideration or whether the aim is a long-term building-up of phosphate residues in the soil.

Another article in this number of immediate value to many farmers is that on poultry feeding, by Mr. L. A. Elmer. He bases his recommendations on the firm ground of the work of the Rowett Research Institute and a recent "Growmore" leaflet issued by the Ministry of Agriculture, England. Throughout he translates their conclusions into terms of East African supplies and conditions. An interesting pendant to his article is provided by a note from Zanzibar on dried blood mash.

In the series "Empire Production of Drugs" the prospects of ephedrine production in Kenya are discussed by Mr. V. A. Beckley. In view of the native climate of the therapeutically important *Ephedra* species, it is not surprising that some of them have shown little disposition to grow well in Kenya, but fortunately the species richest in ephedrine is the most promising as a local crop. Since the drug is a component of a large proportion of those proprietary remedies, the advertisements of which depict so feelingly the cougher, the sneezer, and the sufferer from catarrh, the marketing prospects should be good. As regards the general question of drug production in East Africa—the position is still far from clear, for although recent official publications[1] have advocated the production of certain drugs within the British Empire, we have yet to learn of any official pronouncement such as would justify East African farmers in taking up the immediate production of these drugs.

Mr. M. D. Graham contributes an account of a noteworthy experiment in native mixed farming in the Nyanza Province of Kenya. With the ultimate object of providing each farming family with a good diet and at the same time improving their soil, the investigator faces at the outset the need to ascertain what the ideal size and stocking of the family unit should be. A striking feature is the success attained already, at the present early stage, in improving the carrying capacity of the grassland by heavy stocking.

Judging from Mr. Graham's article the depredations of vermin are not a factor with which the farmers of Nyanza have to reckon. They are uncommonly fortunate. For in truth over a large part of East Africa the native

[1] Med. Res. Coun. War Memo. No. 3.
Bull. Imp. Inst., Vol. XXXIX, No. 1, pp. 1-17.

cultivator shares his crops with vermin or does no more than get what they leave. In his 1940 annual report one of the Tanganyika provincial commissioners refers to the vermin as a main obstacle to the improvement of native agriculture. In many parts bush-pig are Public Enemy No. 1. (Nothing could be more appropriate than their sub-specific name, *dæmonis*.) In the present number Mr. J. K. Robertson describes how in certain types of country pig-proof barriers can be maintained with a minimum of trouble. In the next number we shall print an exposition of the poisoner's art.

Part one of a timely article which gives expression to the rapidly growing interest in the African, his relationship to the land and the economic and nutritional problems involved, is provided in the contribution, "The People and the Land: Some Problems." Supported by figures collected from a variety of sources, Mr. Maher provides some interesting contrasts between the life of the African in commercial centres and the conditions possible in the agricultural experiments now being conducted by Mr. Graham at Bukura. Mr. Maher has the vision to affirm that the African—in common with other men—does not live by bread alone.

ADDENDA AND CORRIGENDA

Mr. G. H. Warren's article on "Shelterbelts" (pp. 8-19, July, 1941, number)

1. In discussing the distance to leeward over which shelterbelts give protection, a Russian formula was quoted as giving this distance as "$2\frac{1}{2}$ times the square of the height." It should be made quite clear that this formula is intended to apply to measurements made in metres; that is, trees 20 metres high (a little over 60 feet) would give protection for 1,000 metres to leeward.

2. The graph on p. 10, showing the effect of the shelterbelt on wind velocities in proximity to it, refers to four different "structures" of shelterbelt, which are not defined in the text. These are:—

Structure I—Shelterbelts "open" throughout their height.

Structure II—Shelterbelts "dense" throughout their height.

Structure III—Shelterbelts "medium dense" below and "dense" above.

Structure IV—Shelterbelts "medium dense" above and "open" below.

3. On page 18, col. 1, lines 2 and 25 from top, *"Phytolima alata"* should be *"Phytolima lata"*.

CORRESPONDENCE

The Editor,

E.A. Agricultural Journal, Amani.

Dear Sir,

In the article on Camphor in the July, 1941, number of the *East African Agricultural Journal*, Mr. Greenway, speaking of the common camphor, makes the following statement: "It is not found in *Ocimum* spp., some of which contain Thyme camphor." This, I fear, is a mis-statement. In the Second Edition of *The Volatile Oils* by E. Gildemeister and Fr. Hoffmann, Gildemeister speaks of oils stated to have been obtained from *Ocimum canum* which contained relatively much d-camphor. On page 11 of my bulletin on Essential Oils (Dept. of Agriculture Bulletin No. 19 of 1931) I refer to a camphor containing oil obtained from *Ocimum canum*. The identification of this shrub was made at Kew; since, however, it has been identified as *Ocimum kilimandscharicum*. This species of *Ocimum* is a relatively quick growing shrub; it will produce from 6 tons to 12 tons of material per acre per cutting. On distillation it gives from 0.2 per cent to 0.6 per cent of a volatile oil from which, on cooling, 15 to 25 per cent of d-camphor has been obtained. This oil has been produced commercially, and camphor from it was sold on the London market.

The genus *Ocimum* carries a multiplicity of oils, a few of which have been investigated here. One contained Eugenol, another, of which only very small samples have been obtained, appears to contain Menthol.

Yours faithfully,
V. A. BECKLEY,
Senior Agricultural Chemist.
Department of Agriculture, Kenya.

THE PEOPLE AND THE LAND: SOME PROBLEMS

PART I

By Colin Maher, M.A., Dip. Agric. (Cantab.), A.I.C.T.A., Officer in Charge, Soil Conservation Service, Department of Agriculture, Kenya Colony

It is very necessary that those who are engaged in furthering African welfare and development should have a clear idea of their aims. The final destination must be known before a suitable road can be chosen if the way is not to be made irritatingly slow, difficult and tortuous.

A basic principle of land use, too often disregarded, yet never neglected without disastrous consequences, is that the people and the land must form a balanced, symbiotic organism. In this complex organism the larger portion, the land, should not deteriorate as though parasitized or exploited, but increase in strength and productivity from its association with man; and man, rather than existing with difficulty in association with an impoverished and degenerated complex of trees, bushes, plants, fungi and bacteria, should increase in biological vigour in his flourishing environment.

As to the African himself, few would disagree about the cardinal points of his necessity. He should obtain a standard of nutrition at least adequate for good health; at least sufficient money to allow of good housing and cleanliness, and at least sufficient clothes to protect him from any rigours of climate to which he may be subjected. When this stage of debate has been reached successfully, opinions become confused and conflicting and ideas nebulous. Many will claim that Western civilization has little to offer the African but the doubtful benefits of speed, the material aids of technical efficiency, the demonstration of the superiority of the high explosive and incendiary bomb over the spear and the bow and arrow as an equitable means of settling differences. So the question of what cultural standards should be attained by the African, even what standard of living to include luxuries and amenities above the bare essentials we postulated earlier, is tacitly and tactfully avoided. It is generally assumed, however, with a kind of superficial benevolence, that an increasing population indicates a state of growing blessedness in any African tribe and that a reduction in infant mortality is a necessary indication of social progress. Standards of living perhaps are capable of clearer definition than are cultural desiderata; but standards of living amongst an agricultural people must ultimately depend on the population densities when all possible improvements in agricultural technique have been achieved.

Poor, eroded land in the Tennessee Valley yields a net income of about £60 a year to families cultivating about twelve acres; to reproduce the African equivalent of these conditions would be no inspiring aim. Yet a *laisser faire* attitude will certainly bring this result. Just as the poor white farmer or negro of the American South has little cash surplus with which to keep the wheels of industry turning, so a half-starved subsistence agriculture in Africa can but produce general poverty. In such conditions the European-owned land alone is likely to produce a saleable surplus and spare cash with which local industries may be fed. This problem is no mere local question; it is world-wide. At present there are 31,774,000 farm people in the U.S.A. living on 6,182,000 farms; yet it is said that, "in view of the rapid concentration in farm production which has taken place in the last ten years it is probably conservative to say that 3,500,000 of the nation's farms in 1940 were physically capable of producing an adequate quantity of foods and fibres for domestic consumption, together with sufficient additional to meet prospective export demand. . . . Any number of farms 'required' over and above the minimum, wherever it is put, is required for some other purpose than that of meeting our national requirements in a way which will make for the most efficient utilization of human labour, and yield the highest *per capita* material standard of living to the farm populations." [1] Mr. Wells, in an interesting article [2] suggests that if need be, 45,000,000 people could support themselves, on a subsistence scale, on 9,500,000 farms in order (i) "to relieve unemployment" and (ii) "to maintain national morals, health and population, and stabilize the national culture".

A critic points out [3] "the national culture might be stabilized, but it would be stabilized on a disgracefully low level." "The status of health and education in the poorer districts of the South is a sufficient example of the standards that will be maintained on family incomes of $10 a week . . .This solution for unemployment is defeatist, it is equivalent to

admitting that we cannot improve our economic circumstances, but must reconcile ourselves to the presence of great masses of unemployed millions on the land where they will eke out an existence on the level of southern or central European peasants."

If one reduces the scale, the problem is identical in East Africa—to make a choice between a relatively small but prosperous agricultural population or a crowded, impoverished and ill-fed community living on a subsistence basis. If given no guidance the native population is likely to multiply till the latter state is attained.

The Smallholding System

The smallholding system, generally considered as a form of tenure by individual ownership, is usually spoken of as the touchstone by which our land problems will be resolved. It is very questionable, however, whether this system is always desirable from the economic point of view, especially if the holdings are so small that the families are obliged to content themselves with something near a subsistence standard. A smallholding system at best is dependent for success on severe control over the individual as regards his social, economic and agricultural relationships with his land. The moral gains may include independence and energy in the people, but not always, while these virtues in the smallholding peasant may be accompanied by less pleasant traits. The sturdy independent peasantry described by the poet too often are the mean, self-centred, close-fisted, ill-fed drudges of reality.

Towards the end of the last century, Professor Voelcker is stated [4] to have said of the *petite culture* of Germany and Belgium: "The position of the small peasant proprietor is simply wretched compared with that of a decent English agricultural labourer. Man, wife sons and daughters, on a small peasant property, have all to work from early morn to night to gain enough to keep body and soul together. They exist upon the most frugal fare, and live in dirty, crowded hovels; as regards food and housing, the English labourer is unquestionably 50 per cent better off than they are. . . . The peasants have no money to cultivate their little fields, or to buy stock; the application of artificial manure, of sufficient home-made dung, and the use of labour-saving machinery are impossible in the *petite culture*. The results are everywhere the same—poor crops, bad earnings, and extravagant value put upon the land (which is considered the only mode of getting a living, as in Ireland), and a hard and miserable existence."

The following is a quotation from a lecture at a conference on political economy at Lyons in the last century regarding the lot of peasant proprietors: "There are, of course, exceptions in everything and everywhere, but what is their present condition in this *grande generalite*? . . . Fearful labour, an enormous amount of physical force spent, too often wasted, by the fault of hereditary routine; a diet approaching that of his own cattle; the necessity of making his wife and children work as much as, or more than, the beasts of burden; the incessant fear that one of a thousand mishaps may destroy in a day the harvest and fruit of a labour of the whole year; the crushing misery of debt, which so often tortures him, renders him low and servile, and against which he must fight, under pain of being devoured by it."

A professor of rural economy stated with regard to these same French peasant proprietors: "Of the eight million proprietors in France, three million are on the pauper roll exempt from personal taxation. Getting rid of one order of landlords and their rents, they have subjected themselves to another though invisible order—the mortgagees—and their heavier and more rigid rents." Unless there is legal machinery by which mortgages of the land may be forbidden, individual ownership, in all countries, is apt to be a mere myth or passing phase before big landlords, banks or impersonal trusts obtain possession of the land, in fact if not in appearance.

For one reason or another a smallholding system as a method of land tenure or of land use is doomed to failure unless it embodies restrictions forbidding the mortgaging of land and its subdivision or inheritance by more than one son and unless a high standard of husbandry is insisted upon whereby the productive power of each holding is maintained. However, unless the population remains approximately constant, the problem of disposing a population surplus to that which can be employed upon the land will be a pressing and difficult one.

In the circumstances accompanying the land use experiments at Bukura which have been described by Graham, the complications attendant upon swelling families, and tangled tribal, family or clan claims on the land, are absent. Further, expert guidance is immediately and continuously available for the head of each

farming unit. In passing, the very high capital investment amounting to Sh. 213 an acre on a six-acre holding, or Sh. 109 an acre if certain implements are used communally by several farmers, is noteworthy. It might be, perhaps, that some modified system of collective farming by farmers working together on a relatively large area of land might reduce the necessary capital investment per acre.

Some Observations on Some Aspects of Land Tenure

The smallholder is dependent for his efficiency and the adequacy of his nutrition on the adoption of some mixed farming symstem; but under East African conditions it is not feasible to keep cattle and grow crops on an area sufficiently small to permit of it being called a smallholding unless the soil is reasonably fertile and the rainfall at least, say, thirty inches a year, with a distribution which is moderately good. Even under these conditions, it must be repeated, unless certain conditions are rigidly imposed, the *status quo* will not exist for long.

In the U.S.A., the home of the "rugged individualist," of the pioneer, of the independent democrat impatient of control by landlord or the state, the number of tenants is increasing by 40,000 each year as the farms fall into the hands of banks, syndicates or prosperous city men. 42 per cent of all farm operators are now tenants and 1,000,000 of these move to a new farm each year. 58 per cent of the equity of farm real estate is in the hands of "non-farm operators". The increasing mechanization of agriculture and the perennial uncertainty of the weather are but two of the factors responsible for this change in land tenure (but it is doubtful, incidentally, whether large-scale farming on eroded areas by speculators will result in more attention being paid to the protection and improvement of the land).

As a result of private enterprise and uncontro'led individualism, associated in so many minds with initiative, efficiency and energy, the U.S.A. exhibits . . . "wasted fuel resources, stripped and denuded forest lands, ghost towns, stranded populations; heavy subsidies to agriculture, gullied and skinned and badly eroded soils; 500,000 farms ruined for farming purposes through accelerated soil erosion; another 500,000 farm families on farms so small that the soil resource will not sustain them on any acceptable levels of living . . . dilapidated buildings, unsightly premises, homeless migrants, hopeless mothers, undernourished children, diseased bodies, vacant hopes, misery and want, unrest and despair . . . the conditions of holding land in this country are such that one-third of all farm families of the nation are now living under such disadvantaging conditions of land occupancy as to reduce their level of living below any acceptable standards of decency." [5] So America! Whither Africa?

Wilhelm Anderson, in the stimulating article which has just been quoted, observes, "the social function of land in all its uses in any nation is to sustain and support all its citizens in all their material wants. Throughout the civilized world there is a general recognition of this function of land; witness the land reforms instituted in various countries to effectuate a more equitable and socially efficient adjustment of population to the land. . . . The adjustment of farm populations to available soil resources is a national problem of the first magnitude; it is not likely to be solved successfully without drastic legislative restrictions on present conditions of holding land."

In a passage which, with a few minor alterations, might have been written with reference to East African problems, he says, "These restrictions should probably relate to size of holding, subdivision, use, and consolidation with another holding, occupation and residence of holder, assignment, letting, taxation, security for debt, alienation, and inheritance. It should soon be possible, on the basis of appropriate state and federal legislation and carefully delineated local land use areas which are reasonably homogeneous as to physical features, to administer such restrictions through state and county boards of agricutlural holdings, established under state law and empowered to determine family size farms or each local land use area. . . . . Many nations have had to contend with the problem of land tenure and have modified their systems of land tenure to farmers in accordance with their standards of living. . . . The land tenure difficulties of this country lie primarily in our utter lack of any legislatively defined national and state policies specifically designed to promote the more equitable and socially efficient adjustment of farm population to available soil resources. This is a problem that every country has had to face after its land has all been taken up and its frontiers closed. To approach the question intelligently we must clarify our thinking concerning the social function of land in national life, and analyse carefully the elements of private property in land as presently legalized, with a view to eliminating elements that obstruct that function."

Anderson goes on to point out that land may be regarded from the point of view of individual farm productive efficiency or of social efficiency. The first, unmodified, "often brings suffering and misery to those who are dispossessed by technological processes." He observes, on the other hand, " A farm family's assurance of freedom and security and a decent living are all deeply rooted in the continuous possession of such a piece of farm land as will serve to sustain it over the years under careful management. This function of sustaining the operating family appears to be the proper and only socially justifiable function of agricultural land."

In applying these conditions to African conditions, it is necessary to place emphasis on the *decent* living mentioned above and to qualify the phrase about "sustaining" a family as representing something higher than a mere squalid subsistence. It should be observed that the inequality in energy and ability which is to be seen amongst African farmers renders it undesirable that all native farmers should be placed arbitrarily on a uniform basis as regards farm size, even if existing barbed wire entanglements of customary rights did not harass any attempt to place land use on a footing which is more efficient both socially and economically. It must be admitted that the smallholding system has many grave objections, unless due regard is paid to the imposition of essential restrictions and safeguards and to the ensurance that such a minimum standard of living shall be obtainable as is considered necessary—a question which will be discussed later. The inquiry will be made immediately, "What alternative system of land tenure is to be desired?" This query cannot be answered without deliberation upon some aspects of the matter which have not yet been touched upon.

Graham has pointed out that there is a physical limit to the amount of land which can be cultivated by one African family. A greater use of implements drawn by animals might increase the area which could be tilled, but this would necessitate an increase in the grazing area, while the necessity for hand-weeding many crops would still place a brake on expansion if no other checks existed. The use of hired labour, whether of a permanent or temporary nature, may suggest itself therefore, in order that the farm family may cultivate enough land to raise the level of life sufficiently.

It cannot be believed, except by those whose minds have been cast in a feudal mould, that the growth of a marked class system—possibly largely fortuitous in that many landholders may have obtained ownership to their land at no distant date by force, cunning or chicanery—is a happening devoutly to be wished for as being in the best interests of the African native. Nevertheless, such a development is proceeding in some degree and is likely to increase in vigour in the future; nor, perhaps, is it wholly to be deplored. The lazy, the ineffectual and the unintelligent cannot expect justly to fulfil other than subordinate functions in African or any other societies. Democracy does not mean equality; Nature herself avoids the level by producing periodically splendid variations from the normal population; but democracy implies equal opportunity and the existence of ladders up which the energetic and the intelligent may climb to a position in which their talents may be fully utilized. Some safeguards, it may be agreed, however, need to be imposed to prevent exploitation of those members of the community who have been less fortunately endowed by heredity; contrary to the beliefs held by many cloud-borne and cloud-obscured idealists, there is no indication that the African landlord would be more solicitous regarding the wellbeing of his inferiors or tenants than many of his prototypes in other lands. Some means must be assured, too, whereby the more gifted or energetic Africans may ascend to their rightful positions in their social groups. In areas where smallholdings, duly regulated, may enable beneficial use to be made of the land, the tribal authority or the State, ultimate owner of the land, is likely to be the most suitable guardian of the rights of the cultivator and most fit protector of those resources of the soil, the decay of which will endanger the whole lofty edifice of commerce and industry, health and freedom which is founded upon them.

The smallholding cry, like any much-repeated slogan, is apt to deafen the reason. The appeal is unheard of other possible forms of land use. One such alternative is that of the co-operative or community farm. Anderson remarks, "If farm people should lose patience with the family-size farm, who is there to say what standards of living might be achieved on a unit of 20,000 acres, half in crop land, organized as a co-operative non-profit corporate holding, with competent management, supporting, say, 200 families, designed as a community enterprise under private landholding auspices? Who is there to

say that such a farm organization could not incorporate industrial elements which would keep all the families occupied throughout the year?" Such a system might have much to recommend it amongst certain African tribes where work in common, based on tribal tradition of mutual assistance against human enemies or against the forces of nature, is not yet too dim a memory. Co-operative enterprises, too, have additional value in communities where the labour of human hands is more easily available than organizing ability such as is required for running efficiently even the smallest farm. Again it would be possible to combine the two systems and utilize communally owned and regulated pasture lands together with individually held arable land. This is no retrogressive suggestion. Grazing associations in certain states of the U.S.A. are using such a system with great benefit. Communal grazing is not bad in itself. It becomes an evil thing when there is no control over stock or pasture.

Before leaving this subject it may be observed that the introduction of "industrial elements" suggested by Anderson in the co-operative farm is urgently needed in the African village. The heavy and continuous drinking of potent liquors which is such an evil feature of many an African native reserve, stultifying all efforts at social progress, is probably largely the result of lack of profitable, amusing or interesting occupation, and the resultant boredom. In many English cities it is only recently that the cinema, the football field, and the dance hall have largely eclipsed the appeal of the "gin palace," which was the Saturday resort of many of the working class. However, this is only one aspect of the emphatic need for industries in Kenya Colony, both on the village and the factory scale. To put it bluntly, there is no hope for the land or the people if the agricultural population remains at 800 to 1,200 people per square mile (or possibly as high as 1,500 people per square mile over limited areas) in some of the moister districts. The limit of the population which can be supported by agriculture or animal husbandry without ruination to the land is of course much lower in the semi-arid areas. Areas upon which too dense a population at present are endeavouring to support life, at even a modest standard of living, are rapidly approaching or have reached a stage at which even the expenditure of huge sums of money could not restore their usefulness to men. The despoliation of soil wealth in these areas is generally accelerated by the primitive methods of agriculture or grazing control which are in use whereby, to gain a copper harvest to-day, all chance of a golden or silver return to-morrow is being recklessly forfeited. Ignorance, conservatism and laziness all contribute to this state of affairs, but above all sheer need is the factor responsible for exploitation of the resources of the land. Socially and administratively the problem is difficult—but not insoluble. Determined efforts must be made to initiate and foster both small- and large-scale industries which will be able to absorb the people surplus to the number which the land can support. While allowing the people left on the land to attain a reasonable standard of life, those people provided for by industry will be enabled to escape a life of inevitable misery, starvation and drudgery during which the land is clawed into shreds by their hopeless struggle, and lost to posterity completely.

REFERENCES

[1] Letter in *Land Policy Review* for January, 1941, from Arthur W. Stuart.
[2] "How Many Farmers do we Require", Wells, *Land Policy Review*, United States Department of Agriculture, Bureau of Agricultural Economics, September, 1940.
[3] Letter in *Land Policy Review* for January, 1940, from Theodore Norman.
[4] *Land*, by James Platt, London, Simpkin, Marshall & Co., 1886.
[5] "Land Ownership and the Nation's Life", Wilhelm Anderson, *Land Policy Review*, November, 1940.

(To be continued)

THAT BLESSED WORD "DEVELOPMENT"

Perhaps the most irrational of all traditions may be seen in the general public's interpretation of the word development. . . . . A fully developed oilfield is one from which the oil has been taken; a fully developed timber area is one in which the trees have been destroyed; a well developed country would presumably be a barren waste. A common complaint against some government agencies is that they have slowed down the "development"—that is the destruction—of some of our national resources.

Now one may develop muscle by exercise, he may develop an urban addition by building streets and houses, but he can hardly be said to develop an orange by sucking it, a forest by burning it, a farm by ploughing it and watching the soil wash down the creek.

J. Ise in *Journal Farm Economics*, February, 1941.

NOTES ON PLANT DISEASES

By R. M. Nattrass, B.Sc. Agric. (Lond.), Ph.D. (Lond.), D.I.C., Senior Plant Pathologist, Kenya

Peach Leaf Curl

This disfiguring and widespread disease not only attacks peaches but also almonds and nectarines. It assumes greater importance at the higher altitudes where low temperatures and high humidity during parts of the year favour its development.

It first appears soon after the leaves unfold and is easily recognized by the much thickened and severely distorted leaves. All stages occur from comparatively small pale yellow blisters to larger areas involving the whole of the leaf blade, which usually develops a reddish colour and may be so curled and puckered that the leaf tip touches the stem. The diseased leaves soon wither and fall early so that heavy defoliation may occur reducing the vigour of the tree and the quality and quantity of the crop. Not only may the flowers and fruit be infected but the shoots also may become swollen and distorted and the destruction of successive growing points may cause the formation of numbers of weak side shoots which develop a "witches broom" effect on which the numerous small leaves quickly turn brown and shrivel.

On the upper surface of the affected leaves a whitish bloom can be seen. This is caused by the spore bearing hyphae of the fungus, *Taphrina deformans*, breaking through the cuticle. During this stage large numbers of spores are produced, some of which become attached to the scales of the dormant buds. These spores, the following season, infect the opening leaves. It is for this reason that it is usual to find most of the leaves of a single shoot to be infected.

Control.—If the attack is a mild one control can usually be effected by removing infected shoots and leaves before the bloom appears. This will prevent the dormant buds from becoming contaminated with spores and so reduce the chance of infection the following season. If the attacks are severe spraying must be resorted to. The trees should be sprayed just before the buds begin to swell with 0.8 per cent Bordeaux Mixture (4:4:50) or with Lime Sulphur at a strength of 1 in 30. Burgundy Mixture, which is somewhat easier to prepare than Bordeaux Mixture, may be used if preferred. A formula recommended by the Royal Horticultural Society is as follows:—Copper sulphate 9¾ oz., sodium carbonate 11 oz., water 3 gallons.

(*Received for publication August*, 1941)

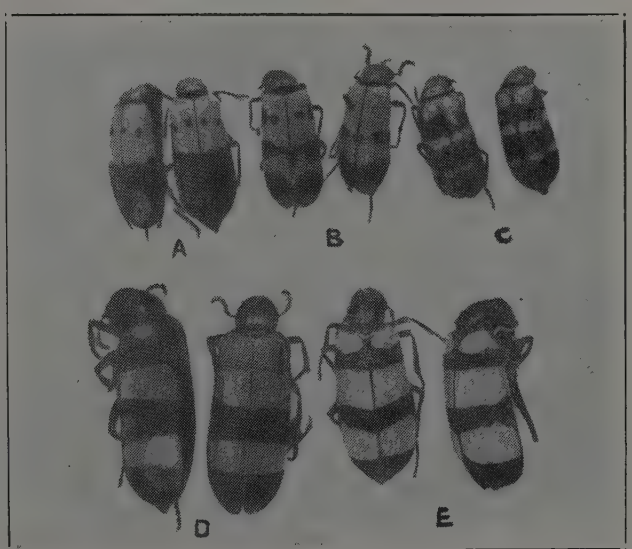
CORN-GROWING AND THE QUIVERFUL

The social effects of the development of agriculture were enormous and comparable only with those produced by the invention of implements and fire. Wheat and barley seeds are very nutritious, compact and lasting. They provide more food than almost any other means for equal amount of labour, and they need little attention while growing. The growers of grain had more leisure than their predecessors, and much less difficulty in storing food for the winter. Their new technique allowed an indefinite increase in the population. Hitherto, the numbers of men had been limited by the amount of game and edible wild plants. These were relatively sparse. Increase in an agricultural population was unlimited as long as virgin soil was still available, for each extra member could support himself by acquiring a new plot of land. Agriculture greatly increased the scope of women and children, as many of its processes, such as weeding, unlike those of hunting, are not dangerous and do not require great strength. It seems reasonable to suppose that agriculture brought a big reduction in infanticide.

J. G. Crowther in *The Social Relations of Science*. p. 17, 1941.

PEACH LEAF CURL

Shoot of peach severely attacked by Peach Leaf Curl.



BLISTER BEETLES

A *Mylabris tristigma.*
B *M. serricornis.*
C *Coryna kersteni.*
D *M. dicincta* (red & black).
E *M. dicincta* (yellow & black)

[*Facing page* 68

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Ephedra intermedia

Ephedra gerardiana

EMPIRE PRODUCTION OF DRUGS

III—EPHEDRINE*

By V. A. Beckley, M.C., M.A., Senior Agricultural Chemist, Kenya Department of Agriculture

Probably because of advertisements of proprietary articles, the drug ephedrine has aroused a good deal of interest in the public mind. When experiments were first started on the growing of various species of *Ephedra* they received too much advertisement. An article in the London *Times* spoke of these experiments as being well under way before we had succeeded in getting a single plant established. Such premature advertisement is liable to lead to disappointment, but it must be stated that most of those who collaborated have maintained their interest remarkably well.

The genus *Ephedra* contains a fairly large number of species which vary in size from dwarf shrubs to a small tree. In all species the leaves have degenerated to mere scales, the work of photosynthesis being undertaken by the stems, which are green; the plants thus resemble the "horsetails". All species are dicecious; that is, there are male and female plants.

One species, *Ephedra sinica,* has been employed in Chinese medicine for many centuries under the name of Ma-huang. Although the alkaloid responsible for the therapeutic effects was isolated as early as 1887, it is only within the last ten to fifteen years that the drug has been employed in European medicine, but the extent of its use has increased immensely.

The alkaloidal content of the various species of *Ephedra* varies from none, or mere traces only, in the North American species, to between 1 and 2 per cent in some of the Old World species. From a therapeutic aspect the most important species are *E. sinica* and *E. equisetina, E. distachya, E. gerardiana* and *E. intermedia.* The main sources of supply are China and Spain, and a fair quantity too comes from India. As a result of the wars in China and Spain supplies decreased heavily, so when in 1937 Mr. Lyne Watt, Senior Agricultural Officer, suggested that it be tried here, steps were taken to obtain material. The Director of the Royal Botanical Gardens, Kew, has been indefatigable in obtaining and supplying cuttings and seed of many species, and to him the Department of Agriculture is deeply indebted.

In March, 1938, a number of cuttings of *E. equisetina* and *E. distachya* arrived from Kew. Most of the former had broken up into short lengths at the nodes; a few, however, remained in fair condition. The *E. distachya* cuttings did not break up to the same extent. All that could be were planted in a sand-box, but gradually one after the other died; a few did show signs of callusing, and were the last survivors.

In October, 1938, one of the collectors of Kew was able to obtain seed of *E. sinica* in the neighbourhood of the Great Wall of China. This was sent us. Some was sent to people who desired to collaborate, but they all reported that the seed failed to germinate. No difficulty was experienced here; perhaps the collaborators, not without reason, had failed to recognize the seedlings. Trouble was, however, experienced with damping-off, so as soon as possible the seedlings were pricked out into banana pots and, as they developed, distributed. Further lots of seed were received in January, 1939, and at the end of April, 1939. No difficulty was experienced with seedlings raised from both these lots. On account of the expense of banana pots, seedlings were pricked out into seed-boxes and no trouble at all resulted.

Reports received from collaborators under all sorts of climatic conditions regarding growth of these plants were most disappointing. Growth was very little or none; in many cases the plants languished and died.

Later, seed of *E. sinica* was obtained from South Dakota. Plants raised from this appeared to do rather better in the early stages, but here too growth has been most disappointing.

At the end of November, 1939, seed of *E. intermedia* was received, and in December seed of *E. gerardiana.* Right from the early stages of growth these two species showed great promise. In March, 1940, seed of *E. intermedia* var. *tibetica* and of *E. nebrodensis* var. *procera,* a Baluchistan species, arrived

* This article, originally submitted by the author as "A progress report of experiments" in Kenya, takes its place naturally in this series.—Ed.

from Kew. Germination was very good, but during the heavy rains of April the seedlings damped off heavily. On removal to the Laboratory verandas, where the seed-boxes could dry out, damping-off ceased, but, unfortunately, most of the plants had been lost.

As most of the *Ephedras* of value as sources of the drug ephedrine are natives of comparatively dry countries having a marked summer and winter, it was believed that the areas in Kenya that would be most suited to the growing of *Ephedra* would be some of our cooler, fairly dry zones, such as Timau and Thomson's Falls. However, in order to obtain the fullest possible information, distribution was wide and covered all the cool zones. Recently, however, a very much warmer zone has been put under trial; reports from here are not yet available. About thirty-five people collaborated in these experiments, but owing to war conditions it has not been possible to obtain reports from all; nevertheless, a sufficient number have been received to enable us to reach some conclusion.

The Western Mau Zone

Climatic conditions cool to cold, humid.

E. sinica.—In most cases died, probably due to long-continued wet conditions.

E. intermedia.—Very poor growth everywhere, plants unhealthy and dying. One report stated that plants not yet planted out looked very well in the boxes.

E. gerardiana.—At one station, probably the driest in the series, very fair growth was recorded and the plants have seeded. At another, in a wetter zone, all the plants died.

Fort Ternan

Climatic conditions fairly warm; not so humid as previous zone.

E. sinica.—Fair but straggly growth.

E. intermedia.—Very fair growth.

Nakuru District

Climatic conditions variable; under Laikipia Escarpment fairly warm with cool to cold nights, comparatively humid, changing to comparatively dry under the Mau Escarpment.

E. sinica.—A failure; one report stated that the only growth occurred during dry weather.

E. intermedia.—Not healthy; straggly growth and suffered from much dying back.

E. gerardiana.—Fair growth, plants bushing out, no signs of flowering.

E. nebrodensis var. *procera.*—Growth not so good as that of *E. gerardiana.*

Gilgil-Thomson's Falls

Climate variable; generally fairly cool; rather humid at high altitudes, but fairly dry at Thomson's Falls.

E. sinica.—Generally very poor or no growth. Many plants died. One report was unusual, stating that the plants tended to die back in dry weather.

At Thomson's Falls there was very fair growth, but this was straggly.

E. intermedia.—A repetition of *E. sinica,* with the exception of Thomson's Falls, where there was good growth, the plants bushing well.

E. gerardiana.—Only two stations received plants, but at the more humid there was very slight growth with a tendency to die back and form weak new growth. At Thomson's Falls this species developed very bushy growth and is flowering.

Kinangop Plateau

Climatic conditions variable; fairly dry at the edge of the plateau to humid under the mountains.

E. sinica.—In no case was good growth reported. Plants died out in the wetter zones. From the drier part there were two reports of flowering. There is a possibility that stray plants of another species may have been included.[1]

E. intermedia.—In the wetter zones very little growth; from the drier zones it is reported that the plants are flourishing and bushing out well.

E. gerardiana.—Only one station in the drier zone received plants, where they are doing really well.

Limuru

Climatic conditions cool and moist, with dry periods.

Both *E. sinica* and *E. intermedia* failed.

[1] That it was probable that a plant of another species was present is borne out by the fact that in the boxes of transplants of a sinigle species sometimes there would be one or two plants of a very different habit, e.g. in a box of *E. sinica* a typical plant of *E. intermedia* would appear. Possibly in the collection of the seed from wild plants, seeds of an occasional plant of another species may have been reaped.

Ngobit

The station where these experiments were conducted has a fairly moist cool climate.

All species failed; *E. gerardiana* did best, but produced very spindly weak growth.

Timau

A dry cool zone. Owing to war conditions reports were received from one station only.

E. sinica.—All varieties died out.

E. intermedia.—Good growth.

E. gerardiana.—Doing very well, much better growth than *E. intermedia.*

Trans Nzoia

Climate variable, warm to hot near Kitale; Cherangani, warm to cool; Elgon, cool. Rainfall, greater part of the year, well distributed; marked dry period.

E. sinica.—Failed in every part.

E. intermedia.—Good growth at Kitale and Cherangani, bushing out. Poor growth on Elgon.

E. gerardiana.—Very good growth in all parts, beginning to flower at Kitale.

Scott Agricultural Laboratories, Kabete

Climatic conditions warm to cool; rainfall not well distributed; two marked dry periods.

E. sinica.—Very little growth and straggly; does not like wet.

E. intermedia.—Most satisfactory, about 18 inches high, branching well and beginning to sucker. Does not like wet.

E. gerardiana.—Growth not so tall as *E. intermedia,* but more bushy; commenced to flower beginning of December, 1940, and seeded. Flowering, however, uneven, so many female plants not fertilized.

E. intermedia var. *tibetica.*—Good growth, showing signs of being very satisfactory.

E. nebrodensis var. *procera.*—Slower than previous species.

Conclusions

The results accruing from these experiments enable the following conclusions to be drawn:

(1) Climatic conditions in Kenya are unsuitable to the growth of *E. sinica.*

(2) *E. intermedia* and *E. gerardiana* will thrive under many conditions in the Kenya highlands.

(3) None of the species so far tried will tolerate wet or humid conditions.

It is not yet possible to do more than indicate what parts of the Colony are most suitable for the growing of *Ephedra* on a commercial scale.

As the value of the plant depends upon its alkaloidal content, assays have been made of material produced at the Scott Agricultural Laboratories. It is stated that the alkaloidal content is highest in the autumn after the seeds have ripened, and that this increases with the age of the stem. Kenya, of course, has no autumn, and at present all of our material is only one year old. Well-grown stems of *E. intermedia* and *E. gerardiana* were cut from the plots here, dried at a temperature of 50° C. and assayed for total alkaloids. The results are as follows:—

	E. gerardiana		*E. intermedia*	
Date of cutting ..	4-2-41	27-3-41	4-2-41	27-3-41
Dry matter ..	30.8%	29.6%	35.5%	27.7%
Total alkaloids in dry matter ..	1.66%	1.69%	1.54%	1.60%

These figures are most satisfactory, especially when one takes into consideration the fact that both plots are well under one year old.

Not all the alkaloids are of physiological vale. Read and Feng[1] give the following proportions of ephedrine in the total alkaloids:—

E. gerardiana .. .. 70-80 per cent
E. intermedia .. .. 30-40 per cent

It is indeed fortunate that *E. gerardiana* is the most promising. Since it is seeding and beginning to sucker, it should not be difficult in the course of the next year to work up a large amount of planting material.

Experiments are being undertaken on vegetative propagation so as to speed up multiplication if possible.

(*Received for publication on 9th May,* 1941)

[1] Read & Feng, *J. Am. Pharm. Ass.,* 1928, 17, 1189, quoted in *Textbook of Pharmacognosy* by G. E. Traese.

NOTES ON THE COMPOSITIONS OF SOME TANGANYIKA FEEDING STUFFS

By M. H. French, M.A., Ph.D., Dip. Agric. (Cantab.), Mpwapwa, Tanganyika Territory

I—The Compositions of Local Dried Fish

There are a number of places in this Territory where dried fish (either smoked or unsmoked) can be purchased, and inquiries are constantly received as to the possibility of using these products for the feeding of pigs and poultry. Analyses have been made of two samples of *Tilapia* sp., as shown in Table I.

Table I
Composition of Dried Fish (*Tilapia* sp.)

	Unsmoked from Lake Rukwa.	*Smoked from Lake Kimagai.*
Crude Protein	48.4	55.0
Ether Extract (Oil)	26.8	17.8
N-free Extract	5.1	6.0
Total Ash	19.7	21.2
SiO_2	1.4	0.3
Soluble Ash	18.3	20.8

It is apparent from these figures that the amount of oil present in dried fish samples can vary very considerably, even when the same fish is being dried. Actually the amount of oil in the dried product is far in excess of the maximum encountered in fish meals prepared in Europe, and the feeding of dried fish containing so high an oil content must always be attended by the risk of tainting the product. If properly dried and sufficiently finely ground such dried fish meals would be of undoubted high feeding value for weaner and breeding pigs, but should be used most carefully for fattening pigs. For bacon pigs it should not be fed after the animals have reached 120 lb. live weight, otherwise there is a grave risk that the final carcasses will have a fishy taste. With pork pigs the feeding of such dried fish should be discontinued after a live weight of 55 lb. has been reached. With poultry, besides the danger of the carcasses developing a fishy taste, there is also the risk of the eggs being tainted. I do not recommend farmers to use more than 5 per cent of such locally available dried fish in poultry rations, and even then a careful watch should be kept on the quality of the eggs so that the amount of dried fish can be reduced immediately if a fishy flavour develops. Dried fish should be omitted from the ration of poultry intended as table birds.

If, however, care is exercised in feeding dried fish and similar local products so that objectionable flavours do not develop in the various animal products, then such feeding stuffs can form most valuable supplements, rich in protein and minerals.

II—The Composition of Sprouted Bulrush Millet

The use of sprouted cereal grains in stock feeding has been popularized in the last few years. Its value lies in the fact that animals get a succulent feed instead of dried grain and, since the grain is germinated under artificial conditions, it can be of great importance when normal succulent foodstuffs are difficult to obtain. Almost any cereal grain can be used as well as certain legume seeds, and maize is probably the seed most commonly employed.

The compositions of two samples of sprouted bulrush millet grown at Mpwapwa are given in the accompanying table. Both were soaked for twenty-four hours in water, to which a small quantity of formalin had been added to reduce subsequent mould development, before they were spread on trays to germinate. Sample A was germinated by sprinkling with tap water, whilst sample B was sprinkled with water containing the following plant nutrients: 0.6 gm. potassium nitrate, 0.1 gm. calcium nitrate, 0.1 gm. ammonium nitrate, 0.3 gm. magnesium sulphate, and 0.1 gm. ammonium phosphate per litre.

Table II
Composition of Sprouted Bulrush Millet Seed (Dry Matter Basis)

	Sample A.	*Sample B.*	*Ungerminated Seed.*
Crude Protein	16.8	17.0	14.1
Ether Extract	3.8	3.9	4.0
N-free Extract	66.1	65.3	75.5
Crude Fibre	8.4	9.2	4.4
Total Ash	4.8	4.6	2.0
SiO_2	1.2	0.7	0.5
SiO_2-free Ash	3.6	3.9	1.5

It is seen from these figures that the use of a nutrient solution did not cause the composition of sprouted grain to be significantly different from that of grain sprouted with normal tap water. However, an appreciable loss of nutrient material occurred in both samples if the total nutrients in the sprouted grain are compared with those present in the original grain. The total dry matter losses were 16.1 per cent and 15.4 per cent for samples A and B. During sprouting, these particular samples were allowed sunlight for three hours daily from the fourth day till the time of analysis, on the thirteenth day and, as a result, they possessed an attractive green colour. Most probably there would be an increase in the vitamin C and also in the vitamin A and

riboflavin constituents, but there can of course be no question that where water is obtainable for irrigation it is more economical for the farmer to grow maize, lucerne or Napier grass as stock feed than to provide germinated grain.

III—The Compositions of Some Green Crops

(*a*) *The Value of Maize and Velvet Bean Mixtures for Ensilage*

For several years it has been the practice at Mpwapwa to plant velvet beans amongst maize which is to be cut for silage making. The beans should be planted when the maize is sown, so that the vines can grow up the maize stalks. The amount of growth made by the velvet bean vines naturally depends on the season, but under Mpwapwa dry conditions, if the beans are planted much later than the maize, comparatively poor growth is made. In Table III are given the compositions of green maize at the milky stage of seed development, and of a mixture of velvet bean vines and green maize (also at the milky stage). The crops were grown on the same field and were both used for silage production. Silage from the velvet bean vines and green maize is very palatable and of higher feeding value than maize silage.

Table III
Composition of Green Crops (Dry Matter Basis)

	Green Maize (Cobs milky).	*Green Maize and Velvet Bean Vines.*	*Cow Cabbages.*	*Spineless Cactus.*
Crude Protein	8.6	12.2	14.3	4.1
Ether Extract (Oil)	1.7	2.5	3.2	1.3
N-free Extract	54.5	54.6	45.1	69.2
Crude Fibre	28.7	24.6	24.8	9.5
Total Ash	6.5	6.1	12.6	15.9
SiO_2	2.3	1.0	1.7	0.6
SiO_2-free Ash	4.1	5.1	10.9	15.3

(*b*) *The Compositions of Cow Cabbages*

Table III gives the analysis also of cow cabbages. It is seen that they do not equal lucerne grown under irrigation, and so, though they are of undoubted feeding value for most classes of farm stock, their lower yields and poorer returns of nutrients per acre make lucerne and Napier grass better crops for the average farmer.

(*c*) *The Composition of Spineless Cactus*

Many varieties of cacti have been recommended as reserves of green succulent foods for the dry season feeding of stock. One of these, the spineless cactus, growing at Mpwapwa, has been analysed and the figures obtained are also included in Table III.

The content of crude protein is low and smaller than that in hay from a mixture of local grasses. The fibre content is lower than in most grasses and the mineral content is comparatively high. The general composition agrees with other published figures, but it appears that cacti will not equal green crops such as maize or lucerne growing under irrigation, nor will they have the feeding value of good hay. Therefore, if hay or green crops can be grown and fed, the cultivation of cacti is not an economic proposition.

IV—Notes on Some Protein-rich Seeds

(*a*) *Dolichos lablab or Fiwi Beans.*—It has been shown[1] that fiwi beans can give almost as heavy a yield of hay as cowpeas in a favourable year, but they do not give such a big return of seed. During the course of these earlier legume trials an analysis was made of the fiwi beans examined. They were brown in colour with a conspicuous white hilum. It is seen from Table IV that fiwi beans are similar in composition to cowpeas, except that they contain more fibre. Like cowpeas, fiwi beans are poorer than velvet beans in ether-soluble matter, but richer in mineral matter.

(*b*) *Soya Beans.*—The composition of soya beans grown at Mpwapwa is seen to be similar to those from other parts of the world. No successful variety has so far been found for the dry arid areas.

(*c*) *Green Gram (Choroko).*—Questions have been frequently received as to what extent this leguminous seed could be used for poultry feeding. Its analysis is given in Table IV and the figures show that it resembles cowpeas in composition. The seeds are very palatable, and though they could form a most useful poultry feed their high price will limit their use.

Table IV
Compositions of Various Protein-rich Seeds
(Dry Matter Basis)

	Dolichos Beans.	*Soya Beans.*	*Green Gram.*	*Sword Beans.*
Crude Protein	26.9	37.1	28.1	28.5
Ether Extract (Oil)	1.6	19.2	1.1	3.3
N-free Extract	53.0	30.5	60.7	56.2
Crude Fibre	14.3	7.6	5.5	8.6
Total Ash	4.2	5.6	4.6	3.4
SiO_2	0.1	0.5	0.2	1.2
Soluble Ash	4.1	5.1	4.4	2.2
Lime (CaO)	0.36	0.54	0.49	0.47
Phosphate (P_2O_5)	0.78	1.28	0.92	0.36

(*d*) *Sword Beans.*—These beans grow very well in certain localities and many inquiries have been received as to their usefuless for stock feeding. Their analysis figures (Table IV) show them to be typical legumes, but my own experience indicates that they are not very palatable to cattle and pigs.

(*Received for publication on 21st May, 1941*)

* *E. Afr. Agric. J.*, 4 (1939), 457; French and Winship.

THE STORAGE OF NATIVE FOOD CROPS IN UGANDA

Compiled from information supplied by Agricultural Officers in Uganda

MILLETS

Compiled by H. R. Hosking, B.Sc., A.R.C.S., A.I.C.T.A.

Eleusine Coracana (*Finger Millet*).—In general there are three methods of storing this crop. The commonest method amongst the people who use this as their staple food and as their famine reserve is to construct large wickerwork baskets which are almost invariably plastered both outside and in with cow dung, either used alone or mixed with black swamp soil or wood ashes. The basket is raised from the ground and supported with poles or on large stones. The wickerwork is made from a variety of materials, e.g. bamboo, elephant grass, reeds, etc. The basket is covered with a conical thatch, which can be raised like a lid to permit ingress or to air the stored crop. In some areas the whole structure is further protected from the weather by an additional thatch supported by upright poles—rather like a primitive Dutch barn. In Teso a similar type of granary is made of bands of grass embedded in mud, one band being coiled above the other until a structure quite as large as those made from wickerwork has been built up. When finger millet is stored in granaries of this type it is usually unthreshed, but in one or two localized areas it is the habit to place only threshed grain in these stores. As far as can be ascertained, it is possible to keep unthreshed heads for ten or more years in stores of this kind, provided that the heads are dried thoroughly in the sun prior to storing. After five years the grain becomes hard and rather unpalatable. I have seen unthreshed millet which was twelve years old; the grain was extremely hard, but there was little or no sign of mustiness or insect damage.

A second method is to make packages of plantain fibre in which the threshed grain is placed. These are hung in trees nearby or at the tops of poles stuck in the ground, or, in one district (Busoga), the packages are suspended from the crossbar of a structure similar to football goalposts. This second method is more frequently found in those areas where finger millet is not the staple food crop, and where it is used mainly for beer brewing.

In certain areas, notably in Ankole, Bunyoro and Toro, the traditional method of storing this crop was the use of large pits lined with plantain leaves. It was found that marauding tribes were only to able to detect these pits with difficulty if they were carefully hidden. Now that settled conditions prevail the use of pits has been discontinued. It is stated that if the top of the pit was sealed with packed soil no insect damage was found. A period of forty-eight hours was usually allowed after opening such a pit before it was considered safe for people to go down to remove the grain. It was usual to put in threshed grain, either loose or done up in banana-fibre packages.

Sorghum.—This crop is mainly used for beer. It is extremely difficult to store it for a longer period than six months. Some tribes store the dried heads in granaries similar to those used for finger millet, but under these circumstances it is eaten fairly quickly or used for beer before many weeks have elapsed. The usual method of storing heads for seed is to make up bundles which may or may not be wrapped in plantain fibre; these bundles are then hung inside the huts in the smoke from the cooking fire. In this way insect damage is prevented. In Busoga it was stated that some people roast the threshed grain before storing it, thus preventing insect damage. If the heads are to be kept only for a short period they are commonly seen hanging on poles near the huts.

GROUNDNUTS

Compiled by M. G. de Courcy Ireland, B.A.

Groundnuts are not a difficult crop to store if they are not shelled and are thoroughly dried before being put away.

In some parts of Uganda, where large quantities of groundnuts are grown, the pods are left to dry on the plant after they have been pulled or dug up. Another method is to pick the pods about the third day after digging and then to dry them at home in the house compound. In favourable weather the drying takes about a week to ten days before the nuts are ready to be put in the store. The stores are of two main types, and are used for millets, cotton and other food crops, except simsim. Both are raised off the ground about nine inches on a framework of poles supported on large stones. The most usual type is made of mud and *Loudetia simplex* grass, is barrel-shaped and varies in size, holding from three or four bags to fifteen or twenty bags. It is covered with a thatched roof which, if the

store is small, rests on the lip of the store; if the store is large the roof is supported on posts. The other type is a pear-shaped wickerwork basket, often made of *Harrisonia abyssinica* and covered with a grass roof. The advantage of this type of store is that is can be transferred easily if the owner wishes to move house.

In Busoga and other parts those who grow only a small amount of groundnuts usually pick the pods off the plant soon after uprooting; the nuts are then taken home and dried in the sun. Later they are tied with banana fibre or *Lusenke* grass (*Imperata cylindrica*) into bundles of various shapes, each holding twenty to forty pounds. These bundles are then stored in one of three places: in the house, outside hung from a tree, or in a forked stick two or three feet from the ground. If they are stored in the house a piece of old pot or jar is put at the top of the bundle to protect it from rats. If the bundle is stored outside in a forked stick or hung from a branch of a tree it is again covered with grass to protect it from rain; if crows and poultry are likely to damage the bundle a few thorn sticks are put around it.

Occasionally small quantities of groundnuts are stored in large earthenware pots and sealed down with mud to prevent rats and children stealing them.

Provided groundnuts are stored in the shell and are thoroughly dry before storage they will keep for at least two years. If they are at all moist when stored they would no doubt be liable to severe attacks by most of the well-known pests of stored products. Occasionally the stored nuts are attacked to a small extent by the larvæ of a moth which is believed to be *Ephestia*.

Plantains

Compiled by T. R. Hayes, M.Sc., A.I.C.T.A.

The preserving of plantains by drying is practised to a greater or lesser extent wherever the crop is of any importance in Uganda. Towards the end of the rains the crop matures in the more favourable regions more quickly than it can be eaten up, and is therefore prepared for storage. In addition to being regarded as a reserve in times of scarcity, it is sometimes used as a pleasant variation to the diet. In former times it was also an article of commerce, being exchanged for hoes, bark cloths, etc. Nowadays the practice is less frequent than formerly, since cotton forms the economic crop and maize meal with all other requirements can be bought with cash.

The variety most favoured for preserving is the beer plantain, as it keeps longer and is said to have a better flavour than other types in the dried state.

The bunch is cut from the tree and often left for two or three days to allow sugars to develop. The fingers are peeled, split lengthwise into two or three slices, and dried in the sun for one or two weeks. The onset of the dry season provides favourable conditions for drying. The slices are laid on mats, or on the swept bare patch in front of the house, or on the roof. Drying takes place more quickly on stone outcrops, and in these modern days sheets of corrugated iron may be used.

The dried slices are then packed in an oval-shaped bundle made of banana fibre and hung up in the house. In other cases, especially if the amount to be stored is great, the large millet granaries are used. This method is not so good as house storage.

It is necessary to keep the product dry, and it generally lasts three to six months. After that time the dried plantains go mouldy or are attacked by insects.

The product can be ground into flour in a mortar and used as such, or cooked whole, mixed with sweet potatoes. In the Bwamba area of Toro District the roasting banana (*Gonja*) is used instead of the beer banana, and converted into flour before storage.

Cassava

Compiled by A. J. Kerr, M.A., A.I.C.T.A.

Both the bitter and the sweet varieties of cassava (*Manihot utilissima* and *M. aipi* respectively) are widely grown in Uganda, but their importance as a vegetable and as a food reserve is a comparatively recent development.

The sweet varieties are generally preferred by the more sophisticated tribes, and these varieties, being of early maturity, are in consequence often harvested, when ripe, for storage above ground. In those areas where cassava is less relished as a food but is necessary as a precaution against famine, the bitter varieties are more extensively grown. They are slower to maturity but will provide edible tubers for several years; and even if they are dug up and stored above ground they keep longer than the sweet varieties. Where the bitter varieties are more predominantly cultivated, notably in the more arid districts of the north, above-ground storage is therefore less frequently encountered.

Whichever variety is stored, the method of preparation is much the same. The tuberous roots are dug usually on the approach of the

dry season. They are peeled, sliced into thin strips, and dried in the sun for a few days; or the roots may be dried whole, in which case the process of course takes longer. Some tribes pound the dried strips to a flour before storing; others store the dried strips, in which case an occasional sunning is given.

The storage receptacle varies according to locality. Frequently the dried cassava is bound up with strips of dried plantain fibre into long bundles, which are then hung from the eaves outside the house, whilst wickerwork stores are commonly used for larger quantities. These stores consist of a round basket, woven from reeds and plastered with cow dung, which is raised on stilts from the ground and covered by a conical lid, the whole structure being protected by a shed.

The sweet varieties only keep for a few (three to six) months when prepared in this way, after which they are liable to become weevil infested, but the bitter varieties will remain in good condition for a year or more. Unlike some other food crops, cassava is not stored in a smoky atmosphere to reduce weevil infestation, as smoking is said to render it unpalatable.

Peas and Beans

Compiled by G. D. Badger, B.Sc., A.I.C.T.A.

Peas and beans form a very mixed group of crops, mostly unimproved and comprising many varieties. These notes refer chiefly to the following:—

Pigeon peas (*Cajanus indicus*).
Common peas (*Pisum* spp.).
Cowpeas (*Vigna* spp.).
Beans (French) (*Phaseolus vulgaris*).
Black gram (*Phaseolus mungo*).

For the purposes of discussing storage methods this group of pulses may be taken together.

There are two main ways of storing pulses: (*a*) in pots; (*b*) in bundles.

(*a*) *Pots.*—Typically these pots are 3 to 4 ft. high, 1 ft. 6 in. to 2 ft. in diameter at the base, tapering to a neck 9 in. to 1 ft. in width. The framework is of basketwork which is plastered inside and out with a mud and cow-dung mixture. The threshed and dried pulses are placed in the pot, which is closed with a lid and sealed a few days after filling. As the only aperture is at the top, it would seem that the carbon dioxide of respiration must accumulate in the pot and act as a preservative.

(*b*) *Bundles.*—The storage bundles consist of the threshed and dried pulse wrapped in grass or banana leaves. With varying frequency, according to locality, the seed is mixed with wood ashes. When completed the bundles are suspended from a tree or the rafters of the house. In the latter method, the importance of smoke is evident. Another method is to pass a pole along the axis of the bundle, after which the pole is inserted vertically in the ground and the bundle fixed securely three to five feet above ground level. In this latter method the crops are sometimes stored in the pod.

Sesame

Generally when simsim is stored it is done in small bulks. Thus in Teso receptacles made of mud and grass (*Loudetia simplex*) are constructed to hold about a hundredweight of simsim seed. They are conical in shape, and the narrow opening is sealed down with mud to keep out moths. These small stores are kept under the eaves of the house. In Lango they may be larger and are often grouped on platforms, one foot from the ground, under a thatched roof. In many districts simsim is made up into parcels wrapped in banana fibre or grass and the parcels, after being smeared with cow dung, are hung up inside the house above the fire. In Bunyoro these parcels are stored inside a large granary of the same type as that used for millet, and simsim may also be stored loose in such a granary. In either case, careful people will remove the simsim every two months or so for re-drying in the sun. In districts where only small quantities are grown simsim is stored in earthenware jars.

(*Received for publication on* 10*th June,* 1941)

Where the land is concerned we are only tenants for life. The immorality of mortgaging posterity is surely the quintessence of immorality and shortsightedness carried to the point almost of madness.

Sir George Stapledon.

PHOSPHATIC MANURING IN KENYA, WITH SPECIAL REFERENCE TO WHEAT

By G. H. Gethin Jones, M.Sc., Soil Chemist, Department of Agriculture, Kenya

Farmers in Britain are aware that a high yield of wheat needs "rich" land and that if this crop is not following a phosphated clover, a well-manured root crop or a bare fallow, it is customary to give wheat a drill application of a fertilizer, such as super-phosphate, providing readily available phosphate.

In Kenya there are many instances where economic returns have been obtained from relatively small applications of superphosphate if given as a strip or ribbon application with the seed drill. The response from other forms of phosphatic fertilizers has generally been less marked and, except in certain districts, farmers have favoured the use of superphosphate. In considering this question of the choice of fertilizer we must bear in mind that, apart from other considerations, the wheat plant needs and absorbs from the soil a large part of its phosphate requirements during its early period of growth. If ample phosphates are not available early on, the yield of grain is necessarily limited, even though more phosphates are available during the maturing of the crop. This means that soil carrying wheat must have ample initial amounts of available phosphates and that these must be maintained at a high level during the first two to three months of growth. The present scarcity and very much higher cost of superphosphate has brought to the fore many problems that must exercise the minds of progressive wheat farmers. The choice of phosphatic fertilizers varies for different soils, and as there are many qualifications to general statements on the manuring of wheat it has been considered that the farmers' problems can best be dealt with by the asking and answering of questions that cover many aspects of the problem. In anticipation of a need for a review of the economic phosphatic manuring of wheat, a good deal of laboratory work has been done, and the new knowledge gained will be incorporated in some of the answers given.

QUESTION 1: *What is the evidence that many of the soils now used for wheat production are in need of phosphatic manuring?*

ANSWER: Many soil analyses of such typical soils have shown that the amount of available phosphates present is low to fairly low and generally below the requirements for high yields of wheat. Again, simple pot-culture tests involving the growing of wheat in typical soils have shown response to phosphates, including an increase in the size of individual grains. Lastly, other laboratory tests, involving the growing of crowded wheat seedlings in a dozen typical Kenya wheat soils and the subsequent analyses of the young plants has shown a very small intake of phosphate. Using the wheat roots themselves as a direct measure of extraction, only in one instance did the phosphate intake show adequate supplies for the production of the maximum yield of grain. In this instance soil analyses also showed good reserves of available phosphates. To this evidence can be added that of many local wheat farmers who report that they have obtained economic returns from the use of relatively small applications—generally in the form of superphosphate—given with the seed drill.

QUESTION 2: *Are there any wheat soils which contain sufficient phosphates for some years to come and to which these remarks and any later recommendations do not apply?*

ANSWER: Yes, there are limited areas and pockets of naturally rich land where phosphatic manuring would not be economic at present. These include any obviously fertile, dark, deep alluvial soils; certain deep, well-drained, high-humus, almost neutral black loams and clay loams, such as occur in the Burnt Forest, Lessos, Elgon and Ol'Kalou districts (and probably elsewhere), and also any known local areas of old boma or hut sites. These soils are known by their capacity to produce high yields of grain in good seasons.

QUESTION 3: *Are there any particular types of soil that require special consideration when deciding on the kind of phosphatic fertilizer to use?*

ANSWER: Yes. The reactive lateritic red soils which immediately absorb and tie up applied water-soluble phosphates, such as superphosphate, need other forms of fertilizer. This special soil type is best represented by the typical red coffee soils. It occurs at Kiambu, Nyeri, Embu, Meru, Subukia, Ol'Kalou, Endebess, Thomson's Falls, Upper Gilgil, Kipkabus, Sotik, and Nandi. There are also the somewhat less reactive, lighter, reddish soils such as occur in the Machakos, Kitale, Hoey's Bridge,

and Cherangani districts. There lateritic soils are characterized by free drainage, good depth, acid reaction, reddish colour, desirable physical properties, and often with a zone of murrum or murrum pellets at varying depths. Again there are the more pinkish red, very acid soils of lower fertility such as occur in the Timboroa–Londiani districts. The above-mentioned soils contain a certain kind of clay colloid which fixes water-soluble phosphates in a much less available form in combination with iron and aluminium complexes. In these cases one would expect more economic returns from the use of the much cheaper non-water-soluble phosphates, such as Seychelles and rock phosphate and more especially finely ground bone-meal, provided that a correspondingly heavier application is given. There are also other soils which exhibit this same property, but to a lesser extent; so that the use of superphosphate is not so disadvantageous and may be justified if the cost per unit value is not very much greater. These are illustrated by the very old, often shallow, less highly coloured soils, though they may exhibit a reddish tinge and show murrum within a few feet of the surface. Such soils occur in the Plateau district, at Soy, Ol'Kalou and Thomson's Falls, and also comprise the better reddish-brown soils such as those found in the Upper Molo, Mau Summit and Ol'Joro Orok districts. The unfavourable property of fixing superphosphate is less in all cases where the soil is less acid and contains more natural or applied organic matter.

QUESTION 4: *Bearing in mind the above soils, where non-water-soluble phosphatic fertilizers are more suitable, what are the relative metrits of such materials as superphosphate, rock phosphate, Seychelles phosphatic guano, and bone meal?*

ANSWER: The answer depends upon the total phosphate content, the availability, the dispersion or the fineness of grinding of the material, and of course the cost. Superphosphate contains about 18 per cent phosphoric oxide, all of which is water-soluble. Rock phosphate is finely ground and contains about 32 per cent of total phosphoric oxide, none of which is water-soluble. Seychelles phosphate is also finely ground and contains 24 to 26 per cent of total phosphoric oxide. Bone meals contain 18 to 26 per cent of total phosphoric oxide, together with 6 per cent to 2 per cent, respectively, of total nitrogen, according to whether they are made from fresh bones with some adhering meat and perhaps a proportion of condemned carcasses or from old leached bones containing but little nitrogenous organic matter. Though these latter materials contain no water-soluble or immediately available phosphates, all three are slightly soluble in the soil and gradually become available to the roots of plants. The rate at which they become available largely depends on the fineness of grinding, their organic matter content, and the nature of the soil and the crop fertilized. Superphosphate, apart from the cost per unit of nutrient, is the most suitable form for almost all soils for wheat, except the above-mentioned lateritic red soils, more especially when these are highly coloured, low in organic matter and more acid in reaction. Superphosphate is specially suitable for the drier, lower and earlier maturing areas and also in light soils having low reserves of humus and available phosphate, when decomposing trash is present during early stages of growth. The water-insoluble forms are more suitable for the reactive red loams and under certain conditions also approach nearer to superphosphate in suitability. These conditions include land that is fairly rich naturally or containing fair supplies of phosphates from past manuring. The water-insoluble forms are also more suitable for acid, high-humus soils approaching those slightly peaty in nature and for areas of high rainfall and slow maturity. When the comparative cost of supers becomes much greater, then a more extended use of the other forms is warranted.

QUESTION 5: *How do you explain the term "unit value" of a fertilizer and what are the present approximate unit values of commonly used phosphatic fertilizers?*

ANSWER: When both the percentage of essential nutrient content such as nitrogen (N), phosphoric oxide (P_2O_5), or potash (K_2O), and the cost of the material delivered on to the farm are known, it is possible to compare the relative "unit values" or the cost of 1 per cent of a ton of nutrient in similar classes of fertilizer. The unit value is simply the cost per ton divided by percentage essential nutrient. The present and the pre-war cost of unit values of phosphatic fertilizers are approximately as shown below. Half value only for the contained nitrogen of bone meal has been allowed for wheat.

	Present.	*Pre-war.*
Superphosphate ..	12/- ..	7/-
Rock phosphate ..	7/- ..	4/-
Seychelles phosphate ..	4-5/- ..	4-5/-
Bone meal	4-5/- ..	4-5/-

We note that the essential nutrient contained in superphosphate costs about two and a half to three times as much as that contained in Seychelles phosphate and bone meal. In other words, we can apply correspondingly heavier applications of these latter materials for the same cost per acre. As imported rock phosphate is not better than Seychelles phosphate and costs about half as much again, we need not consider this fertilizer for wheat, at least unless supplies of Seychelles or bone meal become scarce or much more expensive.

QUESTION 6: *You said that one could give heavier applications per acre of the cheaper forms for the same cost. What are the estimated proportional amounts of these that are necessary to produce the same result with wheat?*

ANSWER: As it would be difficult to give even an approximate answer without some knowledge of the true availability of various materials in different local soils, certain laboratory work was undertaken to measure the actual phosphate intake by the roots of wheat seedlings growing in treated soils. To a series of wheat soils equal amounts of phosphate nutrient were added in the form of superphosphate, Seychelles phosphate and bone meal, all ground to a standard degree of fineness. The crowded young wheat seedlings were later analysed for their phosphate content and, after allowing for the phosphate content of the seed used, it was thus possible to measure the phosphate extracted by the roots with different treatments, or, in other words, the comparative availability of the different fertilizers for wheat. It was found that when equally fine material was used, Seychelles was the least available, superphosphate the most available, with bone meal intermediate. If the availability of the phosphate in Seychelles is taken as unity, bone meal has a value of about 1½ and superphosphate about 2. With a fairly lateritic type of soil, superphosphate was only a little more available than bone meal. In these tests wheat growth was continued for eighteen days only, but most of the added fertilizer was in intimate contact with a dense mass of seedling roots and, in fact, large amounts of phosphate were extracted during this short period. Thus, when the least available material was added at the equivalent rate of 200 lb. per acre of phosphoric oxide, the amount actually absorbed amounted to 15 to 20 lb. per acre, which is approximately the phosphate content of about ten bags of grain. This work does not show the absolute amounts that would be absorbed in the field over a longer period, and where the roots are more scattered, but does indicate the proportional availability when uniformly ground materials were used.

QUESTION 7: *Why do you stress that the three fertilizers were similarly ground? As local bone meal varies greatly in the fineness of grinding, can you give an estimate of the greater quantity of coarser material that would presumably be required to give the same result?*

ANSWER: The fineness of grinding of all non-water-soluble fertilizers is important, as a finer material exhibits a greater total surface area to the soil solution and to the feeding roots that can make contact. In the special case of bone meal, finer grinding must also aid the breaking down of the nitrogenous organic matter by soil micro-organisms. Laboratory tests were carried out so as to obtain a fair estimate of the availability to wheat of the same bone meal ground to five degrees of fineness, varying from coarse material to a fine material similar to that used in the comparative tests with other fertilizers. The fineness of grinding could be expressed in relative surface areas by means of passing the samples through a series of standard sieves. It was found that the availability—again measured by extraction with wheat seedlings—increases directly with the fineness of grinding; thus, a fairly coarse sample (40 per cent passing through a 40-mesh sieve) was less than one-fifth as available as a very fine material (100 per cent passing through a 100-mesh sieve), with intermediate values for bone meal of intermediate grades of fineness. With longer growing periods, the relative lower availability of the coarser samples would probably be somewhat less marked, but for early availability, as required by wheat, the fineness of grinding is of paramount importance, as relatively much smaller applications are required for the current crop. It is also important that the material be uniformly distributed in the soil by the drill, otherwise some of the advantage of using finely ground material is lost. It is essential that cereal farmers, more especially wheat growers, should make certain that they are obtaining finely ground bone meal or bone flour, and that this is evenly distributed, so that the necessary dressing per acre be limited and the cost of manuring the present crop correspondingly reduced.

QUESTION 8: *As this matter has a pronounced bearing on manuring with bone meal and production costs, can you suggest any means whereby farmers can find out the degree*

of fineness and suitability of bone meals offered on the local markets?

ANSWER: In the first place the farmer can examine such materials or samples of them for apparent fineness. If he has any fine-mesh sieves, such as one of 40 meshes to the inch, he can carry out rough comparative tests as to the proportion that passes such a sieve. If all the sample passes through such a sieve, the material is very suitable for annual crops; if 80 per cent passes it is slightly on the coarse side and about half as much again is required; if only 60 per cent passes, it is definitely coarse for cereals, as about twice the dressing is required, and if only 40 per cent passes through the same sieve the material is not suitable for cereals, as too costly a dressing would be required to produce the same result. Perhaps another method would be for potential buyers of bone meal to ask for a statement about the fineness of grinding from the seller, who could obtain such reports from these laboratories. It will be noted that the farmer can well afford to pay rather more per ton, if necessary, for material that is suitably finely ground.

QUESTION 9: *Does the importance of fineness of grinding also apply to Seychelles phosphate and how does the fineness of commercial supplies of this fertilizer compare with bone meal?*

ANSWER: As Seychelles phosphate is not water-soluble, its fineness is of equal importance; again, the finer the material the more rapidly does the phosphate nutrient become available. All supplies of this material analysed at the Scott Agricultural Laboratories have been found to be finely ground and any apparent pellets are soft agglomerates of fine particles. Between 80 and 90 per cent passes through a 40-mesh sieve, and much passes through very fine sieves.

QUESTION 10: *Since the fineness of commercial fertilizers varies amongst themselves and differs from the necessarily uniform materials used in the laboratory work, what modifications are necessary to allow for this variation in the fineness of fertilizers?*

ANSWER: It was previously stated that with similarly ground materials (all passing through a 100-mesh sieve) the availability of the essential nutrient contained in superphosphate, bone meal, and Seychelles was of the order of 2 : 1½ : 1, or in other words the quantities required to give the same result with wheat would be 1 : 1½ : 2. As superphosphate is water-soluble, this value remains unchanged, while the amounts of the others required will increase with coarseness of sample. Calculation, based on the intake of phosphate from bone meal of varying fineness, shows that there would be need for about 3½ units of commercial Seychelles phosphate and varying amounts of bone meal according to the fineness of grinding. With a fine sample, such that all passes through a 40-mesh sieve, about 2¼ units of bone-meal phosphate would be required. With a less fine sample, such that 80 per cent passes this sieve, then about 3½ units are required. With material that is still coarser (60 per cent passing through a 40-mesh sieve) a little over 5 units would be required. If quite unsuitable, very coarse bone meal (40 per cent passing a 40-mesh sieve) is used, then about 8 units, or about twice the 80 per cent grade, would be required to give the same result with the current crop. It will be noted that the phosphate in Seychelles is about equally available as that in fairly fine bone meal (80 per cent passing a 40-mesh sieve), and that it is better than that in coarser bone meals.

QUESTION 11: *Will you now convert these values into equivalent amounts of fertilizers that are required per acre to give about the same result? Can you also give the total nutrient content of these quantities, the gross cost and the net cost per acre for the current crop only, i.e. after allowing for the varying proportions that go to build up soil reserves?*

ANSWER: If we assume that superphosphate contains 18 per cent and that both Seychelles phosphate and bone meal contain 24 per cent phosphoric oxide, the proportional amounts required, based on 100 lb. superphosphate per acre, are shown in the following table. The total phosphoric oxide content, the gross cost and the estimated net cost of the quoted quantities are also given. The values given in the last column give the net comparative cost after allowing for residual phosphate that is in excess of that supplied in the lowest application of 100 lb. superphosphate per acre.

	Proportional amounts required per acre.	*Total phosphoric oxide content.*	*Relative gross cost.*	*Relative net cost.*
	lb.	*lb.*	*Sh.*	*Sh.*
Superphosphate	100	18	10/00	10/00
Seychelles phosphate	260	62	14/50	10/10
Bone meal—				
100% passing 40-mesh sieve	170	41	9/70	7/40
80% passing 40-mesh sieve	260	62	14/80	10/40
60% passing 40-mesh sieve	400	96	22/80	15/00

It will be noted that the gross cost of the necessary comparative dressings given in column 3 are about the same for superphosphate and very fine bone meal (all passing a 40 meshes to the inch sieve). As much more is required, it costs about half as much again for Seychelles phosphate and a less fine bone meal (80 per cent passing a 40-mesh sieve), and the gross cost becomes greater when still coarser and therefore less available bone meal is used. However, these gross values of initial expenditure do not offer a complete guide in the choice of fertilizer, as they take no account of the varying proportions of nutrient which are not utilized by the current crop and which remain to build up soil reserves. Thus, when the availability is lower and correspondingly heavier applications are required, the total phosphate given and the residual effects are greater. This is illustrated by the values given in the first and second columns. The amount of nutrient (phosphoric oxide) that is removed from the soil in a good wheat crop that yields say 1,500 lb. of grain per acre is about 18 lb. This is derived partly from soil reserves and partly from applied fertilizer. If we deduct this value—which about corresponds to the phosphate added in 100 lb. superphosphate—from the amount applied, we can note the increasing allowances for residual effects that must be allowed for the heavier dressings of less available fertilizers. We note that it becomes uneconomical to use excessive amounts of expensive superphosphate as that portion which goes into reserve is no more suitable in later years than residues from the much cheaper forms. In fact, these latter cheaper residues are likely to be more suitable in the case of the phosphate-fixing lateritic types of soil. In judging the final choice of a phosphatic fertilizer we must considier both the availability which governs the application required by a short-term crop and the residual amount which goes to build up soil capital so that smaller dressings will suffice in later years. An estimate of this relative net cost is given in the last column of the above table.

QUESTION 12: *How did you arrive at the quoted figures for the relative net cost, and what is the choice of fertilizer?*

ANSWER: It is difficult to assess the true value of the non-utilized portion. For permanent crops such as coffee, tea, fruit trees and pastures its value is high, but for wheat, which needs ample early supplies of phosphates in close proximity, it is necessary to allot an arbitrary low value of the order of half that of the cheapest phosphatic fertilizer available. The calculations have been made on the basis of allowing 10 cents per pound, or Sh. 2/24 per "unit value", for the residual phosphoric oxide that is in excess of the 18 lb. supplied in the lowest application of 100 lb. superphosphate per acre. This amount about balances the phosphate removed in a good wheat crop. Thus, again using the above table for noting the comparative dressings necessary, we can deduct Sh. 4/40 (62 lb. — 18 lb. at 10 cents per lb.) from the gross cost of the Seychelles; Sh. 2/30 from the gross cost of the finest bone meal, and Sh. 4/40 and Sh. 7/80 respectively from the gross cost of the two coarser bone meals. It will be noted that very fine bone meal (100 per cent passing a 40-mesh sieve) constitutes the cheapest source of suitable phosphate and that this first choice is followed by Seychelles phosphate and the less fine bone meal (80 per cent passing a 40-mesh sieve). We note that coarser bone meals become increasingly more costly. This stresses the need for using only the finest grades of bone meal for cereal crops; if the material is such that appreciably less than 80 per cent passes through a 40-mesh sieve, then the choice lies with Seychelles phosphate. It must be remembered that phosphates, once applied, are not lost from the soil—except by surface erosion—and there is very little movement except by that brought about by mechanical cultivation. If we take a longer view of the phosphatic manuring of land for a range of crops in a system of mixed farming, and pay less special attention to immediate returns as is the case of wheat production during wartime while the price is above normal, then we can place a higher value on phosphate residues. Thus, the choice is shifted more in favour of the cheaper phosphatic fertilizers.

QUESTION 13: *What value can be attached to the nitrogen and organic matter content in bone meal and Seychelles guano?*

ANSWER: Bone meals contain 2 to 6 per cent of nitrogen, according to the treatment received. This nitrogen is contained in about 15 to 40 per cent of nitrogenous organic matter. Thus, an application of, say, 200 lb. of bone meal per acre would supply 4 to 12 lb. of nitrogen and 30 to 80 lb. of organic matter per acre. In the case of most bone meals now sold, the values would be about 10 lb. nitrogen and 60 lb. organic matter, which is about equivalent to that contained in 50 lb. of sulphate of ammonia or half a ton of good farmyard manure per acre. If this dressing is concentrated, as in a strip application, more

especially in soils low in nitrogen, this amount is likely to benefit the crop, though under the most favourable conditions the increased returns are not likely to be more than about a quarter of a bag per acre. Seychelles, on the other hand, contains only negligible amounts of nitrogen. It is generally less than ½ per cent, so that 200 lb. per acre supplies only about 1 lb. of nitrogen, say equivalent to that contained in a barrow-load only of farmyard manure per acre. The term "Seychelles guano" is a misnomer; it should be called Seychelles phosphate. On the other hand, the decomposition of the small amount of nitrogenous organic matter in Seychelles and the larger but varying amount contained in bone meals that is brought about by soil organisms does hasten the disintegration of these materials with a subsequent greater availability of the contained phosphate nutrient.

QUESTION 14: *In the case of bone meals, is fresh material, with a high proportion of nitrogenous matter, likely to be more available than a fertilizer prepared from old bleached bones that are low in nitrogen and organic matter?*

ANSWER: As this appeared to be of some importance to the wheat grower, certain laboratory tests were carried out on these two kinds of bone meal, together with bone ash containing no nitrogenous organic matter. Since the availability of the same sample of bone meal had been shown to vary with fineness of grinding and as it was not possible to grind different bone meals and bone ash to an equal degree of fineness, a certain similar sieved fraction (120-150 mesh) of the three materials was used. As the phosphoric oxide content varied the weight used in the test was adjusted accordingly. Phosphate intake of wheat seedlings showed that the nature of the bone meal, as long as it contained some bone organic matter, did not alter its availability, but that when all organic matter was removed, as in the case of bone ash, then early availability was greatly reduced. We thus learn that all the non-ignited bone meals are about equally suitable and that their value as phosphatic fertilizers depends solely upon their content of this nutrient and the fineness of grinding already referred to. Generally speaking, wheat growers should aim at obtaining a high-phosphate meal, which of course must be very finely ground.

QUESTION 15: *Finally, can you make some specific recommendations on the phosphatic manuring of wheat?*

ANSWER: There is a lack of evidence from field experiments as to the optimum quantities that are necessary, but from the result of recent laboratory investigations, some of which have been referred to above, one can advise on the kinds and the proportions that can be used. In all cases, bone meal should be the finest obtainable, even if it costs a little more; the fertilizer should be given with the seed drill and precautions taken to ensure that it is uniformly distributed. In another test with wheat seedlings, it was shown that initial intake was greatest when the fertilizer was placed in the immediate vicinity of the seed and that intake was reduced when the fertilizer was placed at increasing distances below the seed and when distributed throughout a five-inch depth of soil. This was the case when the soil was kept moist and it may be that a somewhat deeper placing of the fertilizer may be better in districts subjected to an early dry season where the uppermost soil becomes periodically too hot and too dry for vigorous root development. This can only be verified by suitable field experiments. It is likely that about 100 lb. superphosphate per acre or its equivalent of the other materials is about the optimum average annual strip dressing for wheat. Suitable fertilizers or mixtures can be worked out on the basis of supplying about a similar amount of available phosphate for different soils. If ample amounts of the finest bone meal (100 per cent grade) were available, then this material, together with small additions of superphosphate to ensure immediately available supplies for the first couple of weeks, would be the most economic method of phosphatic manuring. As such supplies are, as yet, not likely to be adequate, we must rely on mixtures of less fine bone meal (80 per cent grade), Seychelles phosphate, and superphosphate. In all cases the quantity of "80 per cent" passing through a 40-mesh sieve bone meal quoted can be replaced by two-thirds of this amount of the "100 per cent grade" bone meal. We can now suggest suitable fertilizers per acre for varying soil conditions. Reference to some of the soils mentioned is given in answer to Question 3.

(1) Reactive, lateritic red loams: 260 lb. of 80 per cent grade bone meal or 260 lb. Seychelles phosphate, or a mixture of these two.

(2) Less reactive, lateritic reddish loams: 210 lb. of 80 per cent grade bone meal or Seychelles phosphate, or a mixture of these, plus 20 lb. superphosphate.

(3) Dark, high-humus, slightly acid soils with good rainfall, but not as rich as those described as needing no phosphates: 200 lb. 80 per cent grade bone meal or Seychelles, or a mixture of them, plus 25 lb. superphosphate.

(4) Similar but more neutral soils at lower elevation, with less humus: 180 lb. 80 per cent grade bone meal or Seychelles, or a mixture of them, plus 30 lb. superphosphate.

(5) Brownish and light-coloured soils, neither highly coloured nor dark: 150 lb. 80 per cent grade bone meal or Seychelles, or a mixture of them, plus 40 lb. superphosphate.

(6) Similar soils in the lower and drier areas used for wheat growing: 120 lb. 80 per cent grade bone meal or Seychelles, or a mixture of them, plus 50 lb. superphosphate.

(7) The last-named soils when light in texture or shallow: 100 lb. 80 per cent grade bone meal or Seychelles, or a mixture of them, plus 60 lb. superphosphate.

The above recommendations refer to wheat soils which have had very little or no phosphatic fertilizer. If they have received several good applications of organic manures or straight phosphatic fertilizers, totalling the equivalent of, say, 5 cwt. superphosphates or 4 cwt. of either bone meal or Seychelles (i.e. about 100 lb. of phosphoric oxide) within the past few years, then certain reductions shown below can be suggested to the above-mentioned dressings.

To soils under (1), owing to their great capacity for absorbing phosphates, give the full applications until about twice the suggested capital amounts (i.e. 200 lb. phosphoric oxide) have been given; after which give about 150 lb. fine bone meal or Seychelles with the drill whenever wheat is sown. With soils under (2), lower reserves of about 150 lb. phosphoric oxide per acre will probably suffice. When this is reached the annual dressing for wheat can suitably be 100 lb. fine bone meal or Seychelles, plus 20 lb. superphosphate. For soils (3) to (7), the first-mentioned lower capital reserves (100 lb. phosphoric oxide per acre) will probably suffice, when applications can be reduced to about half to two-thirds of those suggested above, retaining the same proportion of superphosphate to the cheaper, less available forms. For soil conditions (4) to (7) it is likely that the 80 per cent grade bone meal is more suitable than Seychelles phosphate.

The qualification of 80 per cent grade bone meal has been repeatedly used. This is because material of this degree of fineness has been shown to be equally available with Seychelles; if the bone meal is coarser, then an equal weight of Seychelles is preferable, unless more of such bone meal is given, but this becomes less economic for the current crop. On the other hand, if the bone meal available is appreciably finer than 80 per cent passing through a 40-mesh sieve, then it should be used in preference to Seychelles. Should a special fine bone meal (all passing through a 40-mesh sieve) be put on the market, then about two-thirds only of the above suggested amounts will give the same results with the current crop.

(*Received for publication on 23rd June,* 1941)

THE IDEAL REPORT

Since a report is fundamentally the communication of information or counsel which is desired and which will be used by someone for a particular end, its success depends primarily upon its being planned carefully to meet all the conditions under which it is to serve. The introduction should present a clear statement of the subject, of the purpose, and of the plan of organization of the material treated. It often also includes a brief statement of the conclusion, or recommendation, and sometimes a summary of results or findings. The conclusion should agree and balance logically with this introduction. The body of the report should be so written as to make evident the structural design announced in the introduction. Ideally a report should read coherently and smoothly, and should bear evidence of the writer's mastery of his subject matter in its larger aspects as well as in its minutest details.

J. Raleigh Nelson in *Writing the Technical Report.*

The pragmatic success of which science and organized knowledge have attained has established a tradition that what counts in the world to-day is accuracy and truth, not guessing. . . . However, it should be emphasized that there is still much room for progress in this respect. The many methods of inculcating a popular understanding and respect for the value of unbiased inquiry should receive even more earnest support than heretofore.

Science, 1940.

PROTECTION OF NATIVE PLANTATIONS AGAINST WILD PIG

By J. K. Robertson, B.Sc. (Agric.), Agricultural Officer, Tanganyika

Wild pig have been extremely destructive to native plantations for some considerable time, but this damage has increased enormously of late since the inauguration of compulsory planting of root crops as an insurance against crop losses through drought or locusts. Pig are particularly numerous where there is an abundance of good cover and especially in areas adjacent to Ceara rubber plantations. Areas of sparse population, and where there are considerable stretches of bush between cultivation settlements, also suffer heavy damage, e.g. in tsetse-infested country. Measures adopted in countering pig in both these types of country in Tanga Province have been so successful as to warrant their trial elsewhere. The methods suggested have been adopted only after exhaustive trial of practically all other methods.

Poisoning of pig, chiefly by using white arsenic (arsenious oxide), has often been recommended. In areas of the two types of country specified an intensive poisoning campaign was conducted by a member of the Game Department, whose full-time services were available for the greater part of a year. Largely on account of the unlimited cover and food supplies available, there was in no case any apparent reduction in the numbers of pig. Poisoning by arsenious oxide has the added drawback of the danger of poisoning to human beings.

Protective trenches have been suggested, and where properly constructed, i.e. wide enough to prevent pig crossing and with the sides straight and deep enough to prevent the escape of any that fall in, they can be very effective. In spite of their effectiveness, the labour involved in the digging of these trenches usually precludes their adoption on a large scale.

The next most obvious plan is to construct fences or stone walls, and in parts of the Usambara mountains both of these are seen. Termites are not numerous in this area, and fences of split timber last a remarkably long time. Where termites are present such timber fences are of course useless.

A further method is to plant live fences, either from seed or cuttings, and a great variety of plants can be used in this way. Possibly the best method in this case is to construct a fence of stout upright poles set close together in the ground, using only species that "take" readily from cutting, and thus an impenetrable fence is available straight away. Provided that gaps are filled as soon as discovered, excellent fences can be had. Although this so far has been the most suitable type of protection for native shambas, it has been used very little, since, although natives can usually distinguish between species of trees and shrubs that take readily from cuttings and those that do not, they will seldom go to the trouble of constructing a fence from the former only, and unless this rule is rigidly adhered to the fence is useless in a year's time. A further drawback of this type of fence is that once a pig gets its powerful snout in between two uprights it can usually widen the gap sufficiently to allow its body to pass.

The method found to be most successful is that of laying entire trees (in Ceara rubber areas) or large branches (in tsetse bush) on the ground in order to form an impenetrable barrier. When clearing land in Ceara rubber areas, entire Ceara trees are felled and dragged into position along the line of the fence, the branches of one tree overlapping the trunk of the former, and so on until a formidable fence is constructed. Branches protruding too far on either side can be lopped off and used to fill any awkward gaps in the fence. Such a barrier can be constructed in a comparatively short time and can be made completely proof against pig. Further in the barriers so far constructed it has been found that rubber seedlings soon spring up from seed shed from the felled trees; the stems of these seedlings interlace with the horizontal branches to make the barrier still more pig-proof.

In tsetse-infested bush, similar barriers have been constructed using (for preference) species bearing formidable spines or thorns, but in order to avoid excessive tree-felling, branches only can be used, and a rule enforced prohibiting felling of entire trees. Here again these barriers have been completely successful, especially as bush regeneration has resulted in young bushes, trees or shrubs growing up between and around the felled branches. Naturally, some of the felled branches used must be heavy enough to prevent their being removed by pig, but if the land in question is being cleared for cultivation a certain number of entire trees will be available in any case.

Since isolated fields of root crops always suffer most, a necessary rule to follow is to plant all root crops together (preferably near to the homesteads) and to surround this entire area with a barrier as described above. Construction is preferably by communal labour, and thereafter each person having root crops in the protected area is assigned a section of the fence to maintain in pig-proof condition, the village headman being the ruling authority in cases of dispute. If the land on the outside of the barrier is cultivated and planted to other crops, the danger from fire is comparatively small. Also, on sloping land, the barriers should be laid out on the contour in order to help control surface wash.

It is well to emphasize that the scheme described above is suggested primarily for two types of country: (*a*) Ceara rubber areas, and (*b*) tsetse-infested bush, two areas notoriously infested with wild pig; there is no question of the method being recommended for universal use. This method has been found to be the only one which natives will adopt with a minimum amount of pressure and continue to use without repeated persuasion, and herein I think lies its great value. Some of the protective measures suggested in the past, e.g. trenches or fences of upright poles, have been turned down by natives on account of the labour involved in their construction; this excuse also has been received when advocating barriers of felled timber, but once the method is introduced to any area little persuasion is subsequently required to secure its use on a wider scale. Also, in stockowning districts natives are already accustomed to making temporary cattle kraals or bomas by laying thorn branches in a circle on the ground, and this can be used as an example when describing or demonstrating the method of construction. Barriers, to be proof against pig, must of course be much more robust than these temporary cattle bomas.

The limitations of the method are only too obvious—it presupposes an abundance of timber, but as it is recommended primarily for Ceara rubber areas and tsetse-infested bush, there is no lack of the requisite constructional material. For that matter, Ceara rubber or other quick-growing trees could be specially grown for the purpose. Damage by fire can practically be ruled out, provided the land is cultivated on both sides of the barrier. Termite damage can be very real, but provided gaps are repaired as soon as discovered there is little difficulty in maintaining the fence in pig-proof condition. The larger game animals can of course ruin the fence completely, but the method is recommended only for areas near native homesteads, which are less frequently visited by the larger game animals.

(*Received for publication on 1st January*, 1941)

THE VEGETATIVE REPRODUCTION OF KAPOK

The object of this note is to issue a warning to anyone who may contemplate the propagation of kapok by budding.

The actual technique is simple—90 per cent success has been obtained with patch budding—but care must be taken to choose the buds from the right part of the mother tree. Information has been available for some time that buds taken from the main stem would produce an upright tree, but that, if the buds were taken from a side branch, the growth would tend to be drooping; no evidence was available, however, and as the point is one of considerable practical importance, buddings have been made with buds taken from the two sources mentioned, and observations made on the subsequent growth of the scions. The observations may be summarized in the following table:—

Source of buds	Number of sucessful grafts	Resultant growth. Upright.	Lateral.
Main stem	69	69	..
Side brances	60	13	47

The figures confirm the information already available, and indicate the necessity of using only buds from the main stem if an upright tree is to result.

It is immaterial from what part of the main stem buds are taken or from what tier of side branches; distinction is between the main stem and its branches.

J. C. Haigh in *Tropical Agriculturist* (Ceylon), Vol. 96, p. 164 (1941).

POULTRY FEEDING

By L. A. Elmer, Assistant Agricultural Officer, Kenya

The Ministry of Agriculture and Fisheries in the United Kingdom have published a series of small pamphlets called "Growmore" leaflets which are designed to assist the farmer to maintain his production under war conditions. "Growmore" Leaflet No. 14 gives some interesting hints on feeding poultry, and is the basis of these notes.

In East Africa the difficulties of poultry keepers are much the same as before the war, except that so many people are away serving with the forces that the task of supervision has become a great burden for those left behind, many of whom may not be familiar with the principles of feeding poultry, and it is really for these people that this article is designed.

Prices, however, are much the same, except for wheat, as a reference to the following list recently supplied by the Kenya Farmers' Association (Co-op.) Ltd., Nakuru, will show.

	Quantity. (*bag*).	*Pre-war Prices.*	*March,* 1941, *Prices.*
Chicken wheat ..	200 lb. ..	7/50 ..	10/10
Wheat meal	200 lb. ..	8/50 ..	11/00
Bran	100 lb. ..	4/50 ..	4/55
Pollards	150 lb. ..	7/30 ..	7/30
Crushed maize ..	180 lb. ..	7/50 ..	8/10
Maize	200 lb. ..	8/50 ..	7/10
Barley	180 lb. ..	8/25 ..	7/10
Crushed oats ..	100 lb. ..	8/00 ..	8/00
Oatmeal	112 lb. ..	17/00 ..	17/17
Millet	200 lb. ..	10/00 ..	12/00
Buckwheat	180 lb. ..	12/50 ..	12/00
Rye	200 lb. ..	10/00 ..	12/00
Broken rice ..	200 lb. ..	20/00 ..	20/20
Lucerne meal ..	75 lb. ..	5/25 ..	6/25
Sunflower seed ..	100 lb. ..	6/00 ..	5/00
Sunflower head meal	75 lb. ..	3/00 ..	3/00

Poultry feed will vary in different places according to the cost of certain items and according to what can be grown, and it is hoped that the following notes will help poultry keepers to work out a sound ration under their own conditions.

Rearing Rations for Chicks

The two substances needed in largest quantities as constructive material for the growth of flesh and bone are protein and mineral salts. Particularly during the earlier stages of growth chickens require a higher proportion of these two kinds of foods than are contained in the ordinary cereals.

The time factor too, in rearing birds, must not be overlooked in reckoning costs. The more quickly the birds come to the laying stage the more profitable they are. In an experiment at the Rowett Institute, Aberdeen, chicks brought up on a basal cereal ration were about seven weeks later in coming to the laying stage than any of the other groups which had been fed the same basal cereal ration plus one of the following: (*a*) separated milk (*ad lib.*); (*b*) 10 per cent of meat meal; (*c*) 5 per cent of fish meal.

Amongst rearing feeds, milk is rightly put first. Feeding trials show that the greatest gains in weight of growing chicks have been made by those fed on a mixed cereal ration plus milk. Whole milk is not necessary; in fact, an excess of oil or fat in the food of young chickens may be harmful. Dr. French, of the Veterinary Department, Tanganyika Territory, states (this Journal, Vol. X, No. 3, Nov. 1939, p. 238) that milk or milk products should be fed always fresh or always soured, but never fresh one day and sour the next.

Under artificial conditions, such as the battery rearing system, complex food mixtures are necessary in order to supply all the ingredients required for growth, but under natural conditions, such as with broody hens on free range, comparatively simple feeding mixtures will suffice, as small deficiencies in the mixture will be remedied by the chicks being exposed to sunshine and by such natural foods as green leaves, insects, plant seeds and earthy minerals.

For the first few weeks the chicks can be given a mixture of finely kibbled maize or coarse maize meal and broken wheat or coarse oatmeal, with milk to drink. This simple diet will suffice for chicks with a mother hen on free range.

Under artificial conditions without free range, the following is suggested: Milk, skim or separated, for drinking, plus a dry mash mixture of equal parts by weight of bran, middlings, sifted ground oats and maize meal. If fresh milk is not available, 10 per cent of

meat meal or meat and bone meal should be incorporated with the mash. If groundnut cake is available and cheap, it may be used as a substitute up to about one-third of the meat meal, i.e. give 6½ per cent of meat meal or meat and bone meal and 3½ per cent of groundnut cake. Chicks will not thrive on a completely vegetable diet, and it would be a false economy to reduce the proportion of meat below 6½ per cent when milk is not given. Rickets is not likely in Africa, but if very dull weather be experienced for a long time or where chickens are reared in batteries or under completely intensive conditions, 1 per cent of good quality cod-liver oil should be added to the mash and be very well mixed.

Finely chopped green stuff, such as clover, lucerne, lettuce, green cabbage, or cowpea leaves, can be mixed in with the mash.

It is stated in the leaflet that a small quantity of raw onion mixed with the rations forms a valuable tonic. It is not always easy to have raw onions on hand, but a patch of shallots in the garden will give a constant supply of fresh material. Up to 5 per cent of powdered charcoal in the mash is a great aid to digestion.

Rations for Growing Chickens

A dry mash recommended in the "Growmore" leaflet for growing stock on range consists of (all parts by weight):—

	Parts
Bran	20
Middlings	35
Meat meal or meat and bone meal or fish or groundnut meal or bean meal	7
Ground oats	14
Maize meal	24
	100

This is supplemented by a grain feed of wheat, kibbled maize, oats or barley, or any mixture or combination of these grains. This is best given one-third very early in the morning and two-thirds in the evening just before roosting time.

A word of warning must be given. "Bean meal" in a British agricultural publication will mean some form of *Vicia faba*, i.e. horse bean or broad bean. Uncooked beans or bean meal of the *Phaseolus* species should never be fed to stock or human beings. There appears to be no reason why cooked beans of this family (dwarf beans, scarlet runners, haricots, rose coco, etc.) should not be used to help the protein supply in the ration, but they should be well cooked and mashed before mixing in with the food.

An addition of 10 per cent of pea meal in a wet mash as a substitute for 5 per cent of the meat meal (i.e. one-half) and 5 per cent of the maize meal was fed with success for many months by the writer, and many other locally produced seeds can be fed if intelligently used.

In this connexion poultry keepers are advised not to make sudden drastic changes in the rations of growing or laying birds; if substitutes are desired for economical reasons, the alteration in diet should be made gradually over a couple of weeks.

With regard to the mineral ration, the benefit of a 2 per cent addition to the mash of the following mixture has been proved by experience:—

	By Weight
Salt	1 part
Ground limestone	2 parts
Steamed bone flour	1 part

The salt should be finely powdered and the mineral ration be mixed thoroughly in the mash.

At the Rowett Institute, feeding trials with growing stock showed that deprivation of salt resulted in a higher mortality (up to 20 per cent), and a delay in arriving at the laying stage of about thirty days in the survivors. The number of eggs laid by the survivors in the no-salt group was considerably less than those laid by properly fed pullets. An interesting fact then came to light. The no-salt survivors were put on to fresh green grass and in four weeks' time were equal with the salt-fed birds. Research shows that good pasture contains from 20 to 30 times as much chlorine as an amount of either maize or wheat yielding the same number of food units and also more sodium. This brings one back to the fact that poultry on free range can be fed less carefully than birds enclosed in runs, as any small deficiency in diet is usually overcome.

Laying Rations

The "Growmore" leaflet recommends a daily grain feed of 1 to 1½ oz. for each bird in addition to a wet mash.

The corn can consist of any of the staple grains (wheat, barley, maize, oats), fed singly or mixed. Millets or buckwheat or sorghum

(*mtama*) can be fed as alternatives, but buckwheat should not form more than 20 per cent of the total grain feed. Rye is somewhat unpalatable to fowls, and not more than 40 per cent should be used in the total grain ration.

Birds kept on free range may be fed on chickwheat, but in order to provide the protein required for egg production a daily ration of 1 oz. of ground chickwheat prepared as a wet mash may be used with the addition of ¼ oz. of one of the following protein foods: fish meal, meat meal, meat and bone meal, soya bean meal, groundnut meal, or bean meal (of the horse bean type). This ration, plus 2 oz. of chickwheat per head, should suffice for a reasonably good egg production. As chickwheat is not so nutritious as sound plump grain, an extra ½ to 1 oz. daily is recommended by the British Ministry of Agriculture.

Householders may obtain good egg production with a small number of birds by feeding 1 to 1½ oz. of grain daily supplemented with a wet mash consisting of household scraps boiled in a minimum of water and dried off with pollards, plus one handful of fish meal, meat meal, meat scraps or freshly cut green bone for every ten birds. If protein foods of animal origin are not available, vegetable proteins, such as groundnut meal, soya bean meal or bean meal, may be substituted. If grain is not available, two mash feeds a day may be given, but with only the same amount of protein supplement, i.e. one handful a day for every ten birds. If digestive trouble occurs the birds should be given access to coarsely ground charcoal in troughs.

It must never be forgotten that for egg production the ordinary cereals contain too little lime. Oyster shell or limestone grit is necessary to assist the birds to maintain a good supply of eggs. Under certain conditions it has been found that non-access to oyster shell or limestone grit has reduced egg production by over 60 per cent.

In May, 1939, Ball (this Journal, Vol. IV, No. 6) gave warning that a high magnesium content in the lime fed in the mineral mixture to poultry is highly deleterious and may cause deaths largely due to kidney trouble. He suggested more dependence on oyster shell, which was free from a surplus of magnesium.

I feel that to end this article I cannot do better than reprint the various mashes recommended by Ball, which have been widely used in Kenya and have proved successful.

With Skim Milk

	Brooder (chicks up to 8 weeks).	*Grower (8 weeks to laying).*	*Fattening.*
Pollards	50 parts	45 parts	30 parts
Bran	20 parts	28 parts	24 parts
Maize meal	23 parts	20 parts	50 parts
Meat and bone meal	5 parts	5 parts	4 parts
Minerals	2 parts	2 parts	2 parts
	100	100	100

Laying Birds (with Skim Milk)

Pollards	45 parts
Bran	15 parts
Maize meal	30 parts
Lucerne meal	8 parts
Minerals	2 parts
	100

Or instead of the 8 parts of lucerne meal, 5 parts of soya bean meal (or other vegetable protein) and 3 parts of meat and bone meal.

Without Skim Milk

	Brooder (up to 8 weeks).	*Grower (8 weeks to laying).*	*Fattening.*
Pollards	45 parts	40 parts	30 parts
Bran	18 parts	21 parts	13 parts
Maize meal	18 parts	18 parts	50 parts
Meat and bone meal	9 parts	9 parts	— parts
Lucerne leaf meal	8 parts	10 parts	5 parts
Minerals	2 parts	2 parts	2 parts
	100	100	100

Laying Birds (without Skim Milk)

Pollards	45 parts
Bran	15 parts
Maize meal	25 parts
Meat and bone meal	5 parts
Lucerne meal	8 parts
Minerals	2 parts
	100

Or

Pollards	45 parts
Bran	13 parts
Maize meal	25 parts
Soya bean meal or other vegetable protein	10 parts
Meat and bone meal	5 parts
Minerals	2 parts
	100

In all cases the minerals consist of the following by weight: Salt, ½ per cent, ground limestone, 1 per cent; steamed bone flour, ½ per cent.

[*See also note on "Dried Blood Mash for Poultry" on p.* 97.]

(*Received for publication on 4th August,* 1941)

AGRICULTURAL PRACTICES AMONG THE ANGONI-TUMBUKA TRIBES OF MZIMBA (NYASALAND)

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The Mzimba district of Nyasaland is, by nature of its varying soil fertility, unsuited to economic crop production on any large scale. The native population therefore live at subsistence level, cultivating by shifting methods their two main food crops, maize and eleusine (*E. coracana,* finger millet).

For rough descriptive purposes the district can be divided into two agricultural areas:—

(1) The Eastern Highlands may be regarded to some extent as the extended foothills of the Vipya Plateau. This region is drained by the Kasitu, Lunyangwa and Mzimba rivers, which flow westwards to join the Rukuru River.

(2) The South Rukuru River plain, which includes the North Kasungu–South Mzimba plain and western areas of Mzimba.

Other areas, such as the uninhabited Vipya Plateau in the east and the Henga Valley and Nyika Mountains in the north, are not included in this brief survey.

On the plains and in many parts of the highlands, large areas of permanent grassland are available, and at present the district carries 60,000 head of cattle and approximately 10,000 sheep and goats without showing any signs of general overstocking. A prosperous native ghee industry is well established. It is a district therefore where mixed farming could be introduced with advantage.

To plan our policy with assurance, an understanding of native agricultural practices is a primary necessity, as this entails the minimum of agricultural experiment. The object of this paper is to set forth as briefly as possible general observations on systems at present in vogue amongst Mzimba tribes. This is still possible, as the native has had, as yet, little or no contact with European agricultural methods. No detailed agricultural survey has yet been done.

The vegetation and soils of the area have been described by Hornby *et al.* (1938). Briefly, it can be stated that the vegetation is predominantly *Brachystegia–Bauhinia–Combretum* woodland, which may be of considerable density in some areas. Soils vary greatly, from the fertile red Matondo on the plains, to light, sandy, infertile soils on the highlands. The rainfall varies from 25 to 30 inches per annum, most of it falling in the months December to April. The altitude varies from 3,500 feet to 4,700 feet.

Native Tribes

At present there is almost complete fusion of the two tribes, the Tumbuka and Angoni. The Tumbuka were the original owners of the area, but were invaded and conquered by the Angoni early in the 18th century. While the ruling families remain Angoni, the language and many customs of the Tumbuka have been adopted. How far this applies to agricultural practices cannot be definitely stated.

Opening Bush-fallow Lands

Native farming practices are fairly standardized all over the country, and have no doubt grown up through a long course of experience and adaptation to natural surroundings. At the beginning of any settler's career there comes the problem of how best to break up his new holding that has been under bush for a varying number of years. His tools are primitive and limited to native axe and hoe. Three methods are in common practice:—

(1) The *chisoso* method, with its intense burning of the soil, is well known.[1] The place chosen for cultivation is known as *chaliro,* and trees are cut liberally on areas adjacent to the *chaliro* and laid in portable heaps from July onwards. This operation is referred to by natives as *kugumula mahlahla* (Ng.), *kutema nthebere* or *kusosa* (T.). When the trees have wilted and dried, but before the leaves have commenced to fall, they are dragged on to the *chaliro,* which is now called *chisoso* (T). or *libibi* (Ng.). Trees are piled high over the area and burned during November. Subsequent hoeing after the rains is very shallow, merely sufficient to make a seed-bed for the eleusine crops.

(2) With the *magadi* (Ng.) or *marongo* (T.) systems of opening fallow land, cultivation commences in the autumn (February) during the rains, when the ground is softest. Hoeing is deep and the main idea is to turn the sod and bury the grass. To further decomposition of the grasses, the sods are often heaped together, grass downwards, in small mounds

[1] This is evidently the same as the *Chitemene* system of Northern Rhodesia.

(*matutu*). Clearing the plot of trees takes place later during the winter (October), and these are heaped together and burned in November before the rains. As no extra firewood is carried on to the *magadi*, the heaps of timber cut on the *magadi* are not contiguous and the burnt patches thus created are called *michinga*. Further, as the bush growth is seldom extensive on the *magadi* soils, the fires are never intense.

To form a seed-bed the sods are broken up by the hoe after the rains and the undecomposed grass and rubbish gathered into piles to be used as manure for the maize crop for the following year. Eleusine (*lupoko*) is sown between the rubbish heaps after the first heavy rains, in January.

(3) An improvident owner may allow the season to slip past and he has neither hoed a *magadi* nor prepared a *chisoso*. He may then use the method of *mphuma*. Hoeing commences in November–December, after the first light rains, but as the ground is hard it is a shallow hoeing in contrast to the deep early hoeing in *magadi*. Trees are cut and burnt as on *magadi*, and after a week or two the area is planted in eleusine. The yield is never good. This method is used to enlarge an existing maize garden, maize being planted the second year, or occasionally a *chisoso* garden can be enlarged by the *mphuma* method at the time of planting.

Thus a garden during the first year is either *chisoso*, *magadi* or *mphuma*. It is only in the second year, when maize or groundnuts or beans have been planted, that it is called a *munda*. In the second year a *chisoso* garden is called *chisalala*, and is usually planted up in eleusine again. Discarded gardens are called *sala* (T.) or *lifusi* (Ng.).

Selection of Method to be Employed

The natural query now arises as to why and when does the native employ either one of these methods? What is the underlying principle guiding him in his choice? The whole question actually is one of soil fertility. The infertility of fallow land for maize during the first year is well known. Burning, followed by one year's eleusine crop, is the cultivator's only known method of opening up his garden. Looking ahead, however, he intuitively seeks an answer to the question whether the new garden will, after the eleusine crop, become one worth cultivating for maize. His whole future procedure depends on the answer.

To estimate the fertility of any area the cultivator is guided by the soil colour and existing vegetation. His system of soil classification is simple. Thus he recognizes three primary types:—

(1) *Katondo*, or fertile red soil.

(2) *Chigandasi*, or strong black soil. This type also includes seasonally saturated alluvial soils.

(3) *Msokolowe*, or white sandy infertile soil or stony infertile hilly slopes.

Using this simple soil classification, together with the vegetation present, we can classify the use of any region as follows:—

(1) *Chisoso Cultivation Soils.*—*Chisoso* cultivation is the method *par excellence* for infertile regions where no continued existence is visualized. The native has judged the ground useless for maize production, but by *chisoso* methods he hopes to get an eleusine crop for one or two seasons. Infertility may be:—

(*a*) Primary, as on the *nsokolowe* soils with poor grass cover and *Brachystegia mimosifolia* (*Tuunda*) (T.) dominant; or it may be—

(*b*) Secondary, as on badly eroded areas of *katondo* soil, where all the top soil has been removed. Trees and shrubs on these secondary areas remain practically unchanged, i.e. *katondo* type. But the grass cover resembles that found on *msokole* soils and reflects the lowered fertility, consisting as it does mainly of pioneer species of *Eragrostis Boehmii* Hack., *E. chalacantha* Trin., *E. hispida* K. Schum., *Pogonarthria squarrosa* (Licht.) Pilger, *Diplachne biflora* Hack., *Sporobolus strictus* Franch., *S. panicoides* A. Rich., and *S. pyramidalis* Beauv. Herein lies the wisdom of the cultivator in regarding grasses with their shallow roots systems as his primary guide to *katondo* soil fertility.

(2) *Magadi Cultivation Soils.*—Both the *katondo* and *chigandasi* soils are best seen where slopes have been insufficient to cause serious erosion. They have therefore retained their fertility and provide the native with his permanent agricultural land for maize production. The characteristic of the grass cover is the dominance of *Hyparrhenia* spp., i.e. *H. rufa* Stapf, *H. dissoluta* Steud. C. E. Hubbard, *H. schimperi* Anderss., *H. filipendula* Stapf., and *H. nyassae* (Rendle) Stapf. Other common species present are *Andropogon schirensis* Hochst., *A. gayanus* Kunth. var. *squamulatus* Stapf, *Brachiaria brizantha* Stapf, *Urochloa pullulans* Stapf, *Themeda triandra* Forsk. var.

hispida Stapf, and *Setaria sphacelata* Stapf and Hubbard. This description of course only applies to fallow bush land, as cultivation completely alters the herbage. The distribution of *Cynodon plectostachyum* Pilg. is worthy of note. Many varieties occur and may be found in pure stands in seasonally saturated alluvial grasslands (*damboes*) or on well-grazed areas around villages. The replacement in any area of *Hyparrhenia* spp. by forms of *Cynodon* is a sure indication that the dangers of overstocking exist. The tree vegetation may be described approximately as *Mombo–Mtondo* type (*Brachystegia Boehmii–Isoberlinia paniculata*), but *Brachystegia* sp., *Combretum* sp., *Bauhinia Thonningii*, *B. Petersiana*, *Diplorrhynchus mossambicenses*, *Dichrostachys glomerata*, *Terminalia sericea*, *Ficus* sp., *Dalbergia nitidula*, and *Uapaca kirkiana* are abundantly represented over the whole area.

Amongst this wealth of vegetation there is no doubt that a good stand of *Hyparrhenia* grasses is of special significance as a soil indicator. But other plants have of course their instinctive appeal. For instance, the cultivator welcomes a good stand of *Brachystegia* trees, but dislikes *Dalbergia* spp. owing to their root systems. Many weeds and herbs are also considered.

To bring these soils into full fertility, gardens are opened by the *magadi* method and planted with eleusine. In the second and future years maize is planted, rotated with a legume.

The *mphuma* method of opening fallow land must be regarded as subsidiary to the above two systems of *chisoso* and *magadi*. It is merely a hurried emergency method used mainly to enlarge existing maize gardens. To be even partially successful it demands good soil, so its use in *chisoso* land is limited.

In a future article the *chisoso* method of cultivation will be more fully described. The system described below is that applicable to the more fertile *magadi* soils. The salient feature is the effort made by the cultivator to retain soil fertility by a definite maize–legume rotation.

Magadi Soil Cultivation

During the first eleusine season the cultivator has often planted maize widely spaced, 10 to 15 feet apart, just as a trial. If he is still doubtful, he may again plant eleusine and maize. This time the maize is more closely planted. The maize may be poor, i.e. fertility has not been fully restored. The eleusine will always be poor the second year. This maize–eleusine crop of the second year is often regarded by the farmer as a sort of fallow year, allowing the ground to regain fertility before the proper rotation begins. This exception, however, hardly belongs to standard agricultural practices.

By the *magadi* system he has opened up his field and reaped his first year eleusine crop. His next crop is almost invariably maize–groundnuts. Thereafter for five to ten years, depending on crop yields (i.e. soil fertility and erosion) he alternates between maize–beans or maize–groundnuts.

But before gaining a real understanding of his rotation his system of hoeing must be described. After his eleusine crop the ground is level and free from weeds. After the light November rains the ground is cleared of any tree re-growth (suckers or coppice). Early one morning husband and wife may be found in the field, the husband armed with hoe and the wife carrying her basket of seeds. The husband goes in front, hoeing lightly small areas 4 to 5 feet apart, finishing each by leaving a small depression with the hoe. The wife coming behind drops maize and beans (*nyemba* or *kayera—Phaseolus* var.) into these depressions and covering them over with soil. Bean seeds planted in this fashion with maize are always climbing, early ripening varieties. The number of seeds put in each depression averages three maize and two bean. To these a pumpkin seed or two may be added at intervals.

After a month or so, when the maize is about 1 foot high, the second operation begins. The soil is hoed away from the maize plants and *matutu* (mounds) are formed for groundnuts. Rubbish and old eleusine stocks are buried in these mounds. Inspection of the field now shows maize and beans growing together on the flat about 5 feet apart, with large mounds formed in between them. Groundnuts are planted on the mounds about January.

In reaping the groundnuts the mounds are not destroyed and in the third year maize and beans are planted here in November–December. Late in December a hoeing similar to that described above for the previous year takes place. The soil is hoed away from the groundnut (now maize) mounds to form the secondary mounds in between, over the site of the old maize stocks. Beans are planted on these secondary mounds. Thus in the third season other legumes take the place of groundnuts in the rotation. Three crops are in common use on these secondary mounds, i.e. *Nzama* (Bambarra groundnuts), *khobwe* (cowpeas) and *mbwanda* (*Phaseolus* sp.).

What I wish to emphasize is the definite rotation taking place, i.e. on spots A and B, maize is planted on A the first year in December, while a secondary mound is hoed at B in January for groundnuts. The second-year maize grows on B, while a mound is re-made at A for beans. The third-year maize is again planted at A and a legume mound formed at B, and so on. Maize and beans thus follow each other until the soil is exhausted.

Another point to be noted is that the heaviest hoeing takes place during the rains. The *magadi* hoeing is in February, when the rains are well advanced. The secondary mounds also are formed in December–January to serve for the earlier planted maize crop the subsequent year. This is a definite adaptation to the fact that the months before the rains, October–November, are the hottest of the year. Moreover, the soil all over Mzimba becomes baked hard during the long dry season and the early rains have little softening effect. The native therefore during the cloudy weather of January, when the ground has been well softened by heavy rains, forms his secondary mounds, which are really for planting his maize in the following December. This point is specially clear when the secondary mounds remain fallow, as is frequently the case. We thus have a field with maize grown on the legume mounds of the previous year. In January the ground is hoed to check the weed growth, and the weeds left to wilt in the sun for a few days. The cultivator then commences to shape the secondary mounds, hoeing away from the growing maize and burying the wilted weeds in the heart of his mounds. We now have a garden with mound A growing maize and mound B fallow, with weeds and grass rotting in the centre.

And so the ground is prepared for early planting of maize on mound B the following year. This idea may even be carried a step further. Groups of three mounds may be seen, A in maize, B in beans, and C fallow. The following year, A, which has really lost most of its soil in the formation of B and C, usually drops out and mounds B and C continue the rotation.

The value of the secondary mounds in checking weed growth in the maize crop is also obvious. For instance, especially in the highlands, one sometimes notes a cultivator who has divided his field after the fashion of an English rotation. One portion of his garden he plants early in the rains in maize. After the usual time lag of a native in his own field, he commences hoeing mounds on the second portion for groundnut planting. By the time this operation is complete the season is well advanced and by the time he turns his attention to his maize patch the plants are becoming yellow and choked by weeds. In the true native rotation the operations of weeding and formation of secondary mounds become one task.

The part played by *mapira* (*Sorghum* sp., Kaffir corn) in this rotation merits brief mention. It is planted at wide intervals over the field on the old maize mounds of the previous year. In a field such as this we may therefore see both mounds of the previous year retained, i.e. the old maize mounds in sorghum, the old legume mounds in maize, together with new mounds hoed for the legumes.

The value of rotted weeds as manure is well known. Thus weeds are always buried in the secondary mounds. As noted above, in preparing a seed-bed in a *magadi* or *mphuma* garden, the weeds and dried grasses are always piled in little heaps and left to rot until next year. A garden with these heaps is known as *chikunde* (T.). Pumpkins are often planted in these rotted piles or they may form the basis of a maize mound. Again the old eleusine stocks are valued as manure for the maize *munda*. Apart from the original burning operation in clearing the fallow ground, weeds and crop refuse are never burned but are buried in mounds.

Erosion Control

In an area such as Mzimba, dry farming methods must be adopted. The erosion in Mzimba is almost entirely due to the present faulty agricultural methods of mound planting. As a first step towards control therefore, planting maize on ridges hoed along the contour has been advocated.

As several native farmers around the Veterinary Stock Farms have adopted ridge cultivation, the effect of this new system on the traditional methods described above can be observed. Two chief difficulties arise:—

(*a*) To get his land ridged the native has to abandon his secondary *matutu*, so that his hopes of early planting with the minimum hoeing are lost. To advise a native to start hoeing before the rains have softened the ground is a thankless task. And when the rains have started the native still shows little desire to expedite matters. Days pass and only a few ridges are hoed. Moreover, it is difficult to expect a "hoeing beer party", called in to

assist, to be enthusiastic over a new method. The best we could do was to ridge about an acre for each man and let him get on with his planting by using the mounds over the remainder of the field; or a few ridges were run across the contour of each field 20 to 25 yards apart, with mounds in between, simply as a palliative to check run-off.

(*b*) Another difficulty arose during the first weeding. As noted, weeding is the preliminary to the formation of the secondary mounds, and hoeing is always away from the maize. Faced with weeding ridges, the result was confusion. The ridges were completely broken up and there was a definite attempt to bury the weeds and form mounds. Actually, on inspecting some of the fields, all that was left to indicate that ridges had once existed was the straight lines of growing maize.

As both difficulties centre around the secondary mounds, the value of a system retaining this essential idea was obvious. The following modified plan was evolved therefore on our Stock Farm:—

Ridges were made at least 6 feet apart, instead of 3 feet. Hoeing during January could then be in the traditional method, i.e. away from the maize, but instead of forming a secondary mound for beans or groundnuts a secondary ridge between the original widely spaced maize ridges was formed. This secondary ridge was planted with groundnuts, Bambarra groundnuts or cowpeas and used as the maize ridge for the following year. The secondary ridge of the first year, with little additional labour, therefore becomes the primary ridge of the second year and the planting of maize begins with the onset of rains.

Hoeing is again away from the maize to form a secondary ridge over the remains of the previous primary ridge. By this method all that is best in the existing native system is retained. His rotational method remains undisturbed. On the ridge growing groundnuts or beans the first year maize will be planted the second year, and vice versa. Also all his hoeing will take place during the rains, and he will be able to bury his weeds for manure, as of yore, and weed control will be facilitated.

Another real advantage is that a garden, once hoed in this way, rotates year after year in the traditional way. Whereas, with single ridges, the cultivator is faced, year after year, with the same problem as to how to get his ridges re-hoed sufficiently quickly to cause no delay in planting. Our whole trouble now lies therefore in the initial year. This can only be overcome by demonstrations on our Stock Farms aimed to increase soil preservation consciousness, by an increased number of trained African instructors to make direct contact with the cultivator, and by organized village efforts during the spring months in order to get their gardens ridged within the minimum time.

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(*Received for publication on 22nd November*, 1940)

BAMBOO REINFORCED CONCRETE

War time construction teaches us a lot in connexion with substitutes for well-known building materials. When we cannot get one kind of material we have to use something else, when we cannot afford one type of hutment we must invent a cheaper one and soon.

In the changes in building construction induced by the war, there is probably no greater change in any direction than that going on in connexion with cheap hutting. The Concrete Association of India has been making experiments in this direction and the Army authorities are only too anxious to take advantage of any new process which is produced. It has been necessary to omit steel reinforcing bars as far as possible and split bamboo has been found of the greatest service in this connexion, and one of the simplest and cheapest methods of panelling hutments necessitates the use of the cement gun which sprays a cement sand mortar on to a panel made of split bambo nailed alternately with the convex and concave side outwards and placed 3/16″ apart to give a key to the cement mortar. The mortar is sprayed on to both sides to a total thickness of 1″ to 1½″ and makes a first-class job at a very reasonable price.

Extract from *The Planters' Chronicle*, p. 195, Vol, XXXVI; No. 10, May, 1941.

PINEAPPLE CULTURE IN QUEENSLAND

A series of articles of considerable importance to those engaged in the cultivation of the pineapple and in pineapple canning is to be found in the July, August and December, 1939, and January, March and July, 1940, numbers of the *Queensland Agricultural Journal.*

In his first article in December, 1939 (1), Mr. H. K. Lewcock, Senior Research Officer, describes the history of the Queensland pineapple industry and points out that production of fruit for the canneries is carried out by small independent landowners farming 8 to 10 acres of pines where this crop forms the sole source of income. In Malaya and more recently in Fiji the land is generally owned by the cannery, which leases small plots to tenant cultivators, whereas in Hawaii large-scale methods using mechanical cultivation are employed.

The article contains a detailed section on the plant structure and its functions which may be skipped by those with a little knowledge of botany. In dealing with leaf colour it is of interest to record that chlorosis may result from iron or nitrogen deficiency. In the case of the former the symptoms are most evident in the young leaves and in the case of the latter in the oldest leaves.

The Smooth Cayenne variety is the chief canning pine in Queensland and, indeed, throughout the world, and this variety receives special attention. It is pointed out that this variety has a strong tendency to produce bud sports and, unless rigorous selection is carried out, some of the more frequently occurring bud sports tend to be propagated at a faster rate than the parent type, with the result that distinctive strains are developed. For this reason, the type of Smooth Cayenne which occurs in one country or locality may exhibit characteristics different from those regarded as normal elsewhere.

The writer records the characters of a desirable Smooth Cayenne plant and describes some of the more common of the objectionable vegetative mutations occurring in Queensland plantations. The article contains some excellent photographs.

The improvement of the pineapple by breeding and selection is referred to in general terms, and an account is given of the raising of new varieties from seed, employing controlled pollination. Improvement by selection of vegetative planting material is also dealt with, together with a statement of the principles and practice of plant selection.

In dealing with plant selection the author points out the desirability of being able to distinguish between hereditary variations and those resulting from environmental influences, but accepts that as certain growth characters may originate from either of these causes, minute variations in form or colour which do not markedly affect the productivity of the plant may be disregarded, and cognizance taken of those characters alone which it is desired to eliminate or perpetuate.

In connexion with these points the author stresses the importance of vigour of growth which may result from hereditary or acquired causes. He points out that planting material from wilt-affected plants is more backward in growth and lower in productivity than that from healthy stock, and, similarly, planting material from chlorotic plants is definitely inferior to that possessing an abundance of chlorophyll in their leaves, because the quantity of starchy substances contained in the stem of a shoot determines the rate and extent of the root development which takes place when it is planted. Since plants propagated from weak parent stock are sub-normal in vitality, the offshoots from them also lack vigour, and by this means a modification in vigour resulting from environmental influences may be carried through several generations, although it would not persist indefinitely. Nevertheless, the rejection of all weak-growing, ill-nourished, or diseased plants as sources of planting material will have an immediate effect in raising yields.

In the July, 1939 (2), number of the same publication, Mr. H. M. Groszmann, Assistant Research Officer, has discussed plant selection with special reference to the Smooth Cayenne variety of pineapples in a somewhat similar manner.

In the chapter describing the soil requirements of the pineapple, the author deals with a certain amount of elementary soil science, but makes it clear that the soil requirements of the pineapple are a compromise between the aeration of the soil for root respiration and the adequate retention of soil moisture. Soil aeration is bound up in pore space, which should be adequate and never compacted.

Mulching assists the retention of open soil-structure, as does a high humus content. The sandy loam appears to be the most suitable soil type. Pineapples thrive in an acid soil.

The subsoil must be pervious as well as the top soil. Excessive moisture is harmful, mainly because it causes inadequate soil aeration. In this respect waterlogging may be avoided in a moisture-retentive soil by encouraging the growth of weeds during heavy rainfall periods. Conversely, in a light soil of coarse texture weeds should never be allowed to grow. Drainage is important in very heavy soils, which, however, are not really suitable for pineapples. Sandy loam is suitable in that it can retain moisture for considerable periods and, moreover, responds very quickly to rain after drying out. Conversely, clays are most unsuitable soils where there is irregularity in the seasonal distribution of rainfall, as clays take up water very slowly after drying out.

The shallow-rooting habit of the pine, which depends on the moisture of the first foot of soil, leads to certain practical considerations. The leaves of the pine collect dew and light showers and conduct the water to the small root system. The shallow-rooting habit renders very important any loss of moisture from the surface soil by evaporation. Here again a mulch is favoured and the paper mulch is suggested. Close spacing of plants so that the leaves protect the soil from the sun and wind is also valuable. Within limits the drier the locality the closer should be the planting. Cultivation should be only superficial and enough for weed destruction. Deep cultivation is held to reduce soil moisture and should not be practised during the crop growth.

In dealing with climatic influences, it is pointed out that the pineapple requires a warm equable temperature, moderate rainfall and high atmospheric humidity, growth being almost entirely inhibited below 60° F. High temperatures, 90° or more, may cause scalding of succulent foliage of young plants and wastage of fruit through sunburn. The optimum mean annual temperature is from 70° to 80° F., a condition usually obtained in oceanic areas. Aspect in Queensland may cause a difference of several weeks in the ripening period. In Hawaii, without irrigation, pineapples are grown in areas of only 15 to 20 inches of rainfall. Long daylight periods and fine days increase the sugar content of the fruit. Dense ratoon fields, in which no desuckering has taken place, expose less leaf surface to light, the leaves in this case being semi-vertical and fruits small and not sweet. Shading also decreases productivity. For this reason wider spacing is advocated in cloudy wet areas than in dry ones.

In the August, 1939 (3), number, Mr. James H. Gregory, Instructor in Fruit Packing, writes an article entitled "Pineapples for Canning," which is of great interest and assistance to those engaged in the practical work of receiving and processing canned pineapples. The size classification of the factory fruit is given, the basic grades being determined by measuring the diameter of fruit with metal rings placed over the top end of the pines. Illustrations revealing the centres of good and bad-shaped fruits are a feature of the article.

J.C.M.

[*Note.*—In East Africa mealy-bug attack and the wilt that follows it have been found to affect pineapples very seriously; they might in some localities well be the limiting factors in commercial production.—L.R.D.]

(1) *Queensland Agricultural Journal*, December, 1939; January, March and July, 1940: "Pineapple Culture in Queensland," by H. K. Lewcock.

(2) *Queensland Agricultural Journal*, July, 1939: "Pineapple Plant Selection," by H. M. Groszmann.

(3) *Queensland Agricultural Journal*, August, 1939: "Pineapples for Canning," by Jas. H. Gregory.

THE FARMER FIXED

The good water supply and the sustained fertility of the soil made the valleys of the Euphrates, the Nile and the Indus exceptionally attractive after the technique of the cultivation of plants had been invented. . . . . The necessity for reclaiming land from the original swamps gave an extra spur to co-operation and discipline in work. Unlike the migrating farmers in open country, the farmers in the valleys repeated the same operations year after year. They acquired a new degree of regularity in working habits, which assisted specialization. . . . .

The control of the distribution of flood waters created a new weapon of social discipline. If a farmer would not obey the rules of the society, or was obnoxious to the custodians of its traditions, and therefore described by them as disrespectful to the gods, he could be instantly disciplined by the threat to cut off his water supply.

J. G. Crowther in *The Social Relations of Science.*

BOWSTRING HEMP OR SANSEVIERIA FIBRE

By P. J. Greenway, Systematic Botanist, East African Agricultural Research Station, Amani

In the *Cordage World* recently there has been some correspondence on the possibilities of Bowstring Hemp or Sansevieria Fibre. Many people have been interested in this fibre in the past, and numerous concessions have been granted in East Africa for the harvesting of the wild plant, but it is doubtful if any of them have been commercially productive. It may be noted that there is practically no literature on the fibre characteristics, and it does not appear that any special claims have been made for it.

A monograph on all the known species of *Sansevieria* was published in the *Kew Bulletin* in 1915, when 63 species were listed, of which 54 species were recognized. Twenty-five of these are recorded in East Africa. Since 1915, eight more have been recognized, none East African, bringing the total known species to 62.

Unfortunately, this monograph gives no indication of those species of value for their fibres, and any published record previous to 1915 on a so-called species giving a good fibre has to be discounted as the nomenclature of the species was very inaccurate. The only two the fibres of which are specifically mentioned are *S. caulescens* N. E. Br., from Kenya Colony ("the leaves are brittle so that they are probably of little or no value for fibre"), and *S. robusta* N. E. Br., Kenya Colony between Voi and the Teita Hills ("this species yields an abundance of fibre of good quality"). In the *Kew Bull. Add. Ser.* XII, "Cultivated Crop Plants of the British Empire and the Anglo-Egyptian Sudan," p. 154 (1936), seven species are listed as in cultivation for their fibres or as ornamental plants.

The species vary greatly in habit and habitat. An unidentified species has procumbent stems and needle-like leaves 3 in. long, *S. Dooneri* N. E. Br. has up to 20 narrowly lanceolate flat 20-inch-long leaves to a tuft, *S. Kirkii* Baker, 1 to 3 flat strap-shaped leaves up to 9 ft. long to a tuft; *S. singularis* N. E. Br., a solitary cylindrical leaf up to 8 ft. long; and *S. conspicus* N. E. Br., which is similar to *S. Dooneri*, has three to five leaves to a tuft, each up to 30 in. long. The species are restricted in their habitat; some only grow in association in extremely desolate country, dry thorn-bush, under an annual rainfall of 10 to 20 in.; others form small groups of a single species on rocks in tropical evergreen rain-forest with a rainfall of 80 in.; two or three species can often be seen growing as the dominant ground-cover on coral rock just above high-water mark and frequently deluged with sea water.

It is those species, such as *S. intermedia* N. E. Br., *S. robusta* N. E. Br., and *S. singularis* N. E. Br., found growing in the dry areas, that are used by the natives for making string, rope, and matting bags, whilst the short-leaved *S. conspicua* has fibres of a suitable length for the Zanzibar and Pemba fishermen to make a kind of sun-hat.

The reasons for the failure of the commercial exploitation of *Sansevieria* fibre from the wilds can be given as follows:—

In areas of *Sansevieria* that look suitable for exploitation the fibre-producing kinds are not found by themselves, and the stands may contain as many as three or four different species, of which one or two may be quite worthless for their fibres. It appears that those which do yield the best fibre—a subject demanding further investigation—have only one to eleven leaves, and are never found in large enough quantities for their fibres to be put on the market with the regularity needed to create a demand. Moreover, plants cut in the bush do not easily recover. The question of water supplies and food for a labour force in uninhabited country has to be considered, and any system of decortication that requires water which has to be transported over bush roads will add greatly to the cost of production.

One of the writers in the *Cordage World*, after mentioning that "*Zaylanica* is the variety which holds definite promise," incorrectly adds that "this plant has a wide distribution over East Africa." Actually, *S. zeylanica* Willd., as its name indicates, is a native of Ceylon, and (to quote the monograph on Sansevieria) "the accounts of the fibre obtained from plants grown in India, Mauritius and Jamaica probably refer to those or some other species, and not the true Ceylon plant."

True, *S. zeylanica* is described as having five to eleven leaves up to 30 in. long to a tuft, and the writer in the *Cordage World* quotes a Jamaican report "that the yield of leaf by weight per acre is about ten times greater than sisal. It would be interesting to know the basis of this estimate. From investigations carried out in East Africa it is known that sisal may produce from 180 to 230 com-

mercially productive leaves, each from 3 to 5½ feet long. At Amani, on plants growing naturally, that is, without cutting, the total number of leaves produced by sisal before poling varies between 185 to 255. Others cut periodically from four years after planting produced between 217 and 294 leaves. Thus it is clear that a very dense stand of *Sansevieria* will be required to produce the same number of leaves per unit area as sisal.

It would be interesting to know how long a plantation of *Sansevieria* remains in production when compared with sisal. If a solitary-leaved species like *S. singularis* was planted and cut when mature, all the leaves being removed at one cutting, the plant would soon be exhausted.

Of the 25 species of *Sansevieria* in East Africa there are undoubtedly some with valuable fibres which could be put to a number of specific uses, whilst others are quite worthless. As a concession project, *Sansevieria* from the wilds is unlikely to pay, for the reasons already given. It can hardly be considered as a plantation crop until more is known about the different species, their behaviour in cultivation, their fibre characteristics, and the most suitable decorticators for their extraction. When this knowledge has been obtained the question will remain whether *Sansevieria* fibres can be considered a commercial proposition and whether they will be able to compete in a market with other fibres both natural and artificial, some of which are already overproduced.

(*Received for publication on 25th March*, 1941)

DRIED BLOOD MASH FOR POULTRY

By the Department of Agriculture, Zanzibar

The provision of an inexpensive form of animal protein in the ration of laying fowls is frequently a matter of some difficulty, consequently a description of the method employed in Zanzibar of preparing a protein-rich ingredient for inclusion in the mash of laying hens may be of general interest.

Ox blood from the slaughterhouse is mixed with wheat bran in the following manner: Blood fresh from the beast is poured on to heaps of bran and worked into the bran, the proportion of blood to bran being 1:3 by weight. The mixture is dried in the sun for from three to six hours and then bagged when thoroughly dry. The bran blood mixture is used in a mash with the following constituents: Bran blood, 45 per cent; maize meal, 20 per cent; millet meal, 20 per cent; coco-nut cake meal, 15 per cent; salt, 1 per cent approximately (the whole containing 17 per cent of digestible protein, 60 per cent of starch equivalent).

The mash is mixed with cold water to a state in which it adheres without the exudation of water when grasped firmly in the hand. In addition, whole grain is provided at the rate of 2 oz. per day in the form of sorghum, bulrush millet or maize. The total ration has a digestible protein value varying from 14 per cent to 16 per cent, and starch equivalent from 77 per cent to 79 per cent. This ration is suitable for between 40 and 66 per cent egg production; that is, production of some 20 eggs per month, depending on the grain used in the dry ration.

Wheat bran imported into Zanzibar now costs some Sh. 24 per 100 kilograms, and rice bran, which absorbs blood equally well, and costs only Sh. 5 per 100 kilograms, is being used to replace half of the wheat bran. The type of rice bran obtained locally when used alone in admixture with blood tends to become mouldy during humid weather, whereas used along with wheat bran this defect does not develop. Rice husks and rice bran are now being used together in an attempt to eliminate the use of the more expensive wheat bran.

(*Received for publication on 16th June*, 1941)

MYLABRIS BEETLES

By W. V. Harris, Entomologist, Tanganyika Territory

The drug cantharadin is obtained from beetles of the family Meloidae, the blister beetles. Best known of these is the "Spanish Fly" of the Mediterranean and Black Sea areas (*Lytta vesicatoria*), but related species are also exploited commercially in China. Cantharadin is present in the blood and accessory glands of the beetle, and is exuded when the insect is disturbed. If this exudate is rubbed on the skin, as for example while knocking off a beetle, blisters are produced. The small black and yellow *Cylindrothorax strangulata* is mainly responsible for the epidemics of linear blisters on the face and neck, occurring in most localities at certain seasons. Cantharadin is extracted from the dried bodies of the beetles.

The larger blister beetles of the genus *Mylabris* are common in Africa. In South Africa their distinctive yellow and black coloration has given them the name of C.M.R. beetles, after the uniform of the Cape Mounted Rifles. In Tanganyika, the commoner species are *Mylabris dicincta,* red and black, but also with a yellow and black variety, about one and a quarter inches in length; *Mylabris tristigma, M. serricornis, M. aperta,* and *M. bipartita,* all yellow and black and smaller than *M. dicincta.*

The female Mylabris beetles lay large numbers of eggs underground at the end of the rains and early in the dry season. The larvæ which hatch out feed on the egg masses of locusts and grasshoppers until fully developed, when they hibernate through the hotter weather, and the adult beetles emerge in waves as the rains cease. Mylabris beetles feed mainly on blossoms, and to a less extent on leaves. They favour the flowers of beans of all kinds, of sweet potatoes, and particularly a small mauve convolvulus-like weed of sorghum fields known as *viazi vya pori.* Sorghum heads, as the grain begins to set, are also visited in numbers. The main season of their appearance is limited to about two months, June and July in the Eastern Province, rather earlier in the west, and later in Moshi and Tanga. Small numbers of beetles may be collected, however, at most seasons.

Large-scale collection is possible only during the limited season of abundance, if costs are to be kept low. Child labour is suitable for this light and rather tedious work. Jars, gourds or bags with string at the neck are preferred by collectors, but half gunny bags, tied to the waist, will serve. The beetles are killed by dipping them for half a minute in boiling water, in cotton bags. They must then be spread out to dry in a thin layer in the sun for four days at least. Drying is a smelly business, and is best carried out away from offices or dwellings. When thoroughly dry, so that sweating is not likely to occur during storage, the beetles should be bulked in clean bags and stored in a dry place.

Approximately 400 beetles of the larger species weigh one pound. The amount collected per child per day varies greatly, for a variety of reasons, but averages just under one pound. The maximum so far obtained in the writer's experience is three pounds. Loss in weight during drying amounts to sixty per cent, which includes the loss of legs and antennæ, so that the equivalent daily collection per child in dry beetles is about six ounces. Assays of dried *Mylabris dicincta* beetles carried out by Dr. W. D. Raymond, Government Analyst, Dar es Salaam, show that they have a cantharadin content of roughly 3 per cent when carefully prepared, whereas the usual Spanish Fly is less than one per cent.

[*Note.*—From information furnished by the Senior Entomologist, Kenya, it appears that although 24 species of Mylabris beetles occur locally, most of them are found at the lower elevations, and in his opinion the beetles "certainly could not be collected in quantity" in Kenya.—*Ed.*]

(*See illustration facing page* 68)

In war, as in peace, to young and old alike, animals may be, and should be, a fount of joy and inspiration. It was Thomas à Kempis who said: "If indeed thy heart were right, then would every creature be to thee a mirror of life, and a book of holy doctrine." All men, provided they are not too ignorant, too proud, or too sophisticated, are bound to take a delight in animal life; and fortunate are those who have learned to see, in the wild things of nature, something to be loved, something to be wondered at, something to be reverenced, for they will have found the key to a never-failing source of recreation and refreshment.

Dr. H. B. Cott, in the preface to his *Adaptive Coloration in Animals* (1940).

REVIEWS

PARENT STOCK AND DERIVED TYPES OF AFRICAN CATTLE, by J. H. R. Bisschop; *S. Afr. J. Sci.*, 33 (1937), 852.

The latest theories on the origins of existing African cattle cannot fail to interest everyone (from research workers to designers of Government live stock improvement schemes and to commercial cattle breeders) associated with cattle improvement in East Africa.

In a most interesting article, Bisschop reviews the conclusions of previous workers, and presents evidence that, instead of three parent stocks of African cattle, there are four basal types. He ends by concluding that:—

"Real and lasting improvement of our cattle can only be brought about when those responsible for the cattle industry are fully conversant with the genetic potentialities of the types and breeds with which they work, and with the limits to improvements which the prevailing environment imposes upon their efforts.

"In order to appreciate the genetical potentialities of their animal material, a very thorough knowledge of the parent stocks from which our types and breeds of cattle originated—of the environmental conditions under which such types and breeds developed into zoo-technical entities—and of the results of crossing such entities, is absolutely essential."

Previous authors have described three parent stocks of African cattle: (*a*) The Hamitic Longhorned cattle; (*b*) the Brachyceros or Shorthorned cattle, and (*c*) Longhorned Zebus. Bisschop presents conformational and anatomical evidence to prove that the Shorthorned Zebu should be regarded as an independent cattle type and not a cross between (*b*) and (*c*).

(*a*) *Hamitic Longhorned Cattle.*—These animals are considered to have been domesticated in Upper and Lower Egypt before or during the neolithic era from the primitive wild cattle of the Nile Valley. They were deep in the body, straight on top and humpless. Their horns were long, erect, lyre-shaped and round in cross-section.

(*b*) *The Brachyceros or Shorthorned Cattle.*—This type was considerably smaller than the Hamitic Longhorns and had much smaller horns. Whereas the latter were beefy in conformation, this type was leaner and had a better developed milk system.

(*c*) *The Longhorned Zebu.*—This type resembled (*a*) in beefiness, but had a sloping rump, a marked dewlap, and laterally placed long horns which were oval in cross-section. It possessed a hump which was wholly muscular in nature and cervico-thoracic in situation.

(*d*) *The Shorthorned Zebu.*—This type is more compact than (*c*) and had short horns which are round in cross-section. The hump is musculo-fatty in nature and thoracic in situation.

In Africa, cattle were first domesticated in Egypt and have since spread over those parts of the continent with suitable environments, usually as a result of human migrations.

At the end of the neolithic era, a powerful invasion into Lower Egypt from Asia caused the Hamitic people and their cattle to be displaced and migrate along the Mediterranean coast into Morocco. Here the migration stream divided, one branch crossing into Europe to leave behind certain Spanish and Portuguese breeds, with the Highland and Hereford cattle of Britain as their descendants. The other branch followed the African coast and, though there are no known Hamitic Longhorns in Africa to-day, descendants can be found in Liberia, Senegambia, French West Africa and Nigeria.

As these Hamitic Longhorns were forced out of Lower Egypt their places were taken by the Brachyceros or Shorthorned cattle brought by the invading people from Asia. This displacement was almost complete in Lower Egypt by 1500—1000 B.C., and the Brachyceros type then spread into Upper Egypt and Ethiopia. However, in the course of time, these Brachyceros cattle were forced to migrate, and they followed the course taken by the Hamitic Longhorns along the Mediterranean littoral. Similarly, when opposite Gibraltar, the migration stream split up, one branch going into Europe to found the present Jersey and Guernsey cattle. The other branch continued round the African coast, and founded the West African Shorthorned cattle now found along the Gulf of Guinea.

In the meantime, at the end of the third pre-Christian millenium, Semitic tribes invaded Africa via Somaliland from Asia, bringing with them the Longhorned Zebus. These animals spread slowly into Upper Egypt and Ethiopia, crossing extensively with the native Hamitic Longhorns. This crossing gave rise to the Sanga type, which has been widely distributed over the southern part of the continent by successive waves of humans.

Fortunately, as a result of people (now known as the Hottentots) acquiring some of these Longhorned Zebus, this basal type has been preserved to the present day. The Hottentots were in the van of the migratory waves, and kept their herds pure because they encountered no domesticated cattle on the way. They followed the great lakes, crossed to South-West Africa and thence to the Cape. The early Dutch settlers arrived in the Cape at a time when the Hottentots and their Longhorned Zebus had reached their southernmost limit, but before the Bantu tribes with their cross-bred cattle caught them up, and the Dutch thus obtained the progenitors of the present Afrikander breed.

The third bovine invasion of Africa occurred much later, coming into Somaliland and Ethiopia from Asia at the time when Persia was at the height of its power, and later during Arab penetration of north-east Africa. Indians and Arabs are considered to be responsible for the Shorthorned Zebu migrations within the continent, chiefly through East Africa and as far south as the Zambesi. A separate branch must also have travelled across the continent, because derived types are found along the Gulf of Guinea.

Crosses between Parent Types.—The only cross that has had a lasting influence on African cattle is the Longhorned Zebu x Hamitic Longhorn, which has given rise to the Sanga type. This has spread from the north-east corner of the continent in successive waves of human migration. Two routes are recognized, the first through the southern end of the Anglo-Egyptian Sudan, skirting the *Glossina* belt of French Equatorial Africa to the region of Lake Chad. From there it has spread into the West African territories, where it is best represented by the Bornu cattle. The main stream spread south via the great lakes to the Zambesi. There it broke into many branches, e.g. to Bechuanaland, Ovamboland, Zululand, Portuguese East Africa, Southern Rhodesia, and the Transvaal.

In East Africa the main cattle population is of the Shorthorned Zebu type, but in the western parts (Uganda, Ruanda-Urundi, and the Bukoba district of Tanganyika) the Sanga type appears. There are many attempts at improvement by crossing the local Shorthorned Zebus with European breeds (which are descended from Brachyceros ancestors), but this interbreeding has not gone far enough to allow of a new type being developed.

M.H.F.

THE AGRICULTURAL ECONOMY OF THE HILL PAGANS OF DIKWA EMIRATE, CAMEROONS (BRITISH MANDATE), by Stanhope White; *The Empire Journal of Experimental Agriculture*, January, 1941.

Hillside agriculture is either arduous or self-destructive. Steep slopes increasing the velocity and erosive power of run-off water, coupled with higher rainfall which is usually found in hilly regions, renders the "erosion hazard," as our American friends would call it, very much greater. Only by increasing the humus content of the soil by every means possible, and by relying to a considerable degree on permanent tree crops, can a staple agriculture and persistent community life be preserved on hillsides.

Habitation of hills is usually brought about through pressure of population on the plains squeezing some of the people up on to the higher lands or through the necessity of seeking refuge, in more inaccessible places and strategically more defensive situations, from hereditary foes. A reason which has some weight also in times of peace is that the soil obtained for agricultural purposes when the cover of vegetation, including forest, is removed from the hills, is very fertile—at any rate for a year or so till the humus accumulated over centuries has been dissipated and erosion takes its toll.

The historic civilization of the Incas was maintained for centuries on steep mountain sides by incredible feats of conservation, including the building of terrace walls with huge blocks of squared stone, each weighing many tons.

The African, however, seldom has much thought for the morrow. Whether through indolence, ignorance, malnutrition or disease, it appears difficult to persuade him that his living space is not limitless or inexhaustible. Confined to a reserve including many steep hills, he will strip the forest from the steep slopes and, by failing to check erosion, gradually force his community into a more and more cramped space. It is seldom, except in isolated areas such as the Sese Islands, that the threat of starvation and extinction teaches the East African wisdom. He does not adopt waste-abhorrent methods at all approaching those of the Japanese or Chinese farmer, forced by pressure of population to grow his meagre food on a mere two or three acres, from which the landlord may claim a third or fourth part of the produce. In Kenya the hills of Machakos, Kitui, Suk, Kamasia, Embu and elsewhere bear witness to the annual deterioration and permanent wastage caused by primitive or ignor-

ant African people living unthriftily, but with a minimum expenditure of effort, on steep hillsides. Tanganyika and Nyasaland could repeat the same dismal story about many areas.

It is all the more interesting to read therefore in this interesting article by Mr. Stanhope White in the January 1941 issue of the *Empire Journal of Experimental Agriculture* of a number of small clans of West Africans, even if the total population is small, who have learnt by experience the lessons which have been preached for years to East Africans with such little apparent result.

In this instance the fear of sudden incursions of neighbouring slave raiders has confined these peoples to a small cluster of hills. Self-preservation has induced these people to conserve their land, while maintaining a population of 170 to the square mile.

The agricultural practice of these people, in the words of Mr. White, "contains practically every principle agricultural departments throughout Africa are trying to instil into the backward peoples. These principles are:—

(1) Conservation of soil and prevention of erosion.
(2) Animal husbandry, wherever poverty does not forbid it, giving mixed farming.
(3) Improvement of soil conditions by the use of farmyard and every other available source of manure.
(4) A system of crop rotation.
(5) Planting and the protection of trees."

It is noteworthy that the introduction of *pax Britannica* in this area has led once again to destruction of the resources of the soil. All terraces, and not least bench terraces, need constant attention and maintenance. But our occupation of this area has led to the abandonment of the terraces by the hillside dwellers who have come down on to the plains. "The slow and laborious work of centuries in gathering and fixing the earth is washed away in a few rainy seasons, and bare and barren hillsides are the result. The terraced areas contain many springs and are well wooded; the de-terraced areas are useless slopes of bedrock with an immediate run-off of rain water, leading to increased erosion on the plains. The heavy rains of 1937 and the excessively heavy ones of 1938 have done much damage in the area."

The comparison of population densities made in this article with those of East Africa are somewhat misleading, since the figures from Lord Moyne's book apply to large areas of several thousand square miles. Boulder-strewn eroding Bunyore Location, North Kavirondo, Nyanza Province, carries over 1,000 people to the square mile. Populations of 1,000 to 1,500 Kikuyus per square mile are known to exist on certain areas in Kiambu and Embu Reserves.

This article is recommended to all agricultural and administrative officers who have to do with natives in hilly districts. It is fruitful of ideas. It is hoped that it will inspire emulation. It is unlikely, however, that imitation of these methods will be procured in East Africa within a space of time commensurate with the rapidity of soil destruction, without considerable firmness on the part of responsible administrative officers.

THE GRASSES OF MAURITIUS AND RODRIGUEZ, By C. E. Hubbard and R. E. Vaughan; Director of Agriculture, Mauritius, and Crown Agents for the Colonies, London, 1940; 128 pp., 16 fig.; Sh. 4/50.

The botany of Mauritius is greatly complicated by the fact that the original vegetation has been to a large extent replaced by introduced species. Accurate knowledge of the grasses present is becoming of increasing importance now that it may be necessary to convert waste areas dominated by scrub into grazing lands. This small book sets out the information in systematic form, with full descriptions of the species and details of the present distribution. A publication on similar lines would be welcome for East Africa.

THE USES AND CONTROL OF NATURAL UNDERGROWTH ON RUBBER ESTATES: Planting Manual No. 6, published by the Rubber Research Institute, Kuala Lumpur, F.M.S., December, 1940; price, $2/50.

This is a revision of the first edition (1934), which must have gone a long way towards finally killing the bad old practice of clean-weeding on rubber plantations and hastened the adoption in its stead of a natural ground-cover of indigenous plants, as opposed to introduced leguminous cover crops. The same practice might well be adopted in Africa with some of our permanent crops, but the choice of plants forming the cover needs to be made with knowledge and caution if excessive competition between crop and natural cover is to be avoided. The complexity of the problem as it affects rubber is well set out in this manual, which deals primarily with the best methods

for establishing, maintaining and controlling indigenous ground cover. The advantages of natural covers, apart from any saving in weeding costs, are summarized as follows: The reduction or prevention of soil erosion and excessive run-off so that more rain is absorbed by the soil; the reduction of soil temperature by shading; the improvement of the soil by the formation of litter, and by increasing its water absorption and percolation capacity.

In the consideration of the problem it is pointed out that the crop and the natural cover underneath it are a living association presenting a struggle in which a suitable balance must be maintained. The choice of ground cover has to be made carefully by selective weeding on the following basis:—

(1) It should be shady but not rapid or voracious; creepers and other plants of highly competitive habit are undesirable.

(2) It should be sappy and rich in nitrogen; tough woody plants are undesirable as they decay too slowly.

(3) Superficial root systems are not objectionable, but deep roots capable of breaking up the soil are very desirable.

(4) The food requirements of the ground cover should be as different from rubber as possible.

In conclusion the following general advice is given for the control of natural covers, once a good mixture has been established: Eradicate all ferns except *Nephrolepsis;* all creepers and thorny plants; most grasses and certain named bushes.

The manual is well illustrated, the eighty-five drawings of cover plants in the appendix being particularly good. We look forward to the promised publication on the subject of the present position of the ground cover problem and the evaluation of the various cover types under varying conditions.

A.G.H.

BACON FOR EXPORT

The following note adapted from *Co-operation and Market News* of the 16th February, 1940, compiled by the Department of Agriculture, Saskatchewan, Canada, may be of interest to pig breeders in East Africa.

"It is important to understand that there are four distinct weights which must be taken into consideration—

1. Live hog weights.
2. Hot dressed carcase weights.
3. Cold dressed carcase weights.
4. Wiltshire weights.

A 200 lb. live hog at the packing plant dressing 75 per cent will yield 150 lb. of dressed carcase. The average shrink of 3½ per cent will reduce the carcase at cold weight to 144.75 lb. Cut and trimmed into Wiltshire sides the cold weights will yield 115 lb. of Wiltshire sides."

The following breakdown shows the transformation of a 200 lb. live hog into Wiltshire sides:—

	Lb.	Per cent
Loss on killing	50·00	25·00
Wiltshire sides	115·00	57·50
Heart and liver	3·50	1·75
Fats	4·25	2·12
Casings	1·25	0·62
Hair	0·80	0·40
Shrinkage	5·25	2·63
Blood and waste	19·95	9·98
	200·00	100·00

The following are given as an illustration of costings. (Canadian dollars have been converted to East African money at 4.45 to the £):—

	Canadian Dollars		*Sh. cts.*	*Sh.cts.*
BUYING PRICE—				
Paid for a 200 lb. Grade 1 sizeable Wiltshire at packing plant, Toronto	18.86		84 76	
		18.86		84 76
COSTS—				
Bruising and rejects ..	.21		94	
Cost of buying, killing and cutting	.91		4 10	
Cost of curing, holding and baling Wiltshire sides	1.46		6 56	
Cost of shipping, loading, paper icing or heating	.09		40	
Cost of freight Toronto to Montreal	.42		1 89	
		3.09		13 89
RETURNS—				
Value delivered seaboard	20.35		91 46	
Value by-products, Toronto	1.60		7 19	
		21.95		98 65

AN EXPERIMENT IN NATIVE MIXED FARMING IN THE NYANZA PROVINCE OF KENYA

By M. D. Graham, Assistant Agricultural Officer, Kenya

The present system of shifting cultivation and consequent waste in the native reserves can only produce enough food for family needs, with a small balance of cash covering taxes and a few articles of clothing. This is the condition of the average cultivator in the more thickly populated parts of the Nyanza Province of Kenya, who suffers from malnutrition and an inheritance of rapidly deteriorating, though once richly afforested and protected, land.

By gross over-cultivation in some districts he has created an overstocking problem, in consequence of which he has been forced to dispose of the majority of his cattle. Although in other parts of the Province this condition has not yet been created, it is only a matter of time before an additional few hundred square miles of country will be over-cultivated and under-stocked. The process is insidious and the gravity of the situation is difficult to appreciate by anyone merely passing through these reserves.

At the Bukura Native Agricultural School in the North Kavirondo District of Nyanza an experiment in mixed farming is in progress. The pupil instruction is only one of the many objects of this experiment. Its immediate end is to find out and teach the proper use of land, with stock as an economic rather than a social asset. Its object is not to demonstrate the value or otherwise of the smallholding or any other specific system, but to show the real advantage of fixed agriculture over shifting cultivation and to provide the basic figures from which improved agricultural systems may later be developed.

The altitude here is 4,850 feet. It is rather hot and humid, with a well-distributed rainfall of nearly 70 in. per annum, having two rather indistinct peaks, in April–May and in August. It is a two-crop area, although the cereal crops of the "short rains" are poor by comparison with those of the "long rains". The former is essentially the pulse season. The site is on the toe of a long spur of land, the central high land being poor, shallow soil, containing much murrum gravel. The slopes are quite good and the bottom lands rich, covered at present with bush and tall tufted grasses.

The central high land, following bush clearing, fairly intensive grazing and frequent mowing since 1924, has now settled down to a short grass cover consisting mainly of *Paspalum scrobiculatum, Hyparrhenia fillipendula, Eragrostis* spp., *Digitaria* spp., *Sporobolus fimbriatus, Setaria sphacelata, Brachiaria soluta, B. brizantha,* with traces of *Cynodon* spp. and numerous other unimportant grasses. Here, too, a large *Cymbopogon* occurs (the finest thatching grass of the country).

The lower, rich soils have, for the most part, a cover of tall tufted grasses such as *Hyparrhenia rufa, Hyparrhenia* sp. aff. *H. collina* Stapf, *Panicum maximum, Beckeropsis uniseta, Sorghum verticilliflorum, Setaria sphacelata, Cymbopogon* sp. (a tall, almost reed-like grass forming thick breaks), and *Panicum trichocladum,* with a giant type of *Cynodon* coming in as soon as clearings are made.

Thirteen mixed farms have been laid out since 1937, varying in size from 1½ to 7 acres, each stocked with native cattle. The fifty African pupils are trained through the medium of these farms, on which they complete a two-years course. To each farm four pupils are allocated, this number being taken to represent approximately the potential labour strength of an average local African family. For comparison, two of the farms are managed by Africans with their families as permanent residents. The farms are grouped in threes for the purpose of pooling implements, gear and work oxen, each farm having allocated to it approximately a third of the total capital outlay, which amounts to Sh. 355 per farm, as against Sh. 977 for a single isolated farm, which still requires the majority of the implements, gear and oxen needed for the three farms between them. Buildings are valued at cost, and total Sh. 300 per farm. The dwelling houses are a double rondavel of sun-dried bricks and the steadings are of poles and thatch. All the materials are made or collected on the main farm. Each farm has a contoured line of bananas, roughly in the middle of the arable, to provide a windbreak, food, and, in time, a solid wash stop. A vegetable garden and fruit trees are sited near the living quarters.

Specific points on which it is hoped that this experiment will yield data are:—

(1) The maximum unit of land that can economically be worked by an average family under these conditions.

(2) The ratio of stock to arable, together with the improvement of indigenous pasture.

(3) The minimum stock and arable requirements together required to produce an adequate diet for the average family.

The Size of the Unit

This is a complex matter, and investigations must be confined for the present to finding out:—

(*a*) The minimum unit of land required for bare family maintenance.

(*b*) The minimum land requirement, over and above (*a*), to provide a reasonable cash surplus.

(*c*) The maximum unit of land that could be properly worked by a family in such a way that no land lies idle.

With regard to (*a*), observations tend to indicate that four acres of our average local land will suffice for the timber, pasture and arable requirements and the homestead. Another two to two and a half acres suffice for (*b*). No investigations have yet been conducted on (*c*), because more positive data on (*a*) and (*b*) must first be collected to provide a guide for the establishment of larger farms.

Observations made so far show that 3 to 3½ acres of land is the maximum acreage that can properly be looked after in the early stages of such a system; but this does not mean that an increase in arable cannot be contemplated after the sixth or seventh year, when hedges, paddocks and buildings are established. Four and a half acres of arable have been tried and have proved too much.

The cash turnover varies greatly, according to the capacity of any group of pupils to adapt their activities to this system. A six-acre unit has shown a turnover of Sh. 600 in a year, including animal products valued at some Sh. 70 per year. This figure can be considerably increased by devoting more arable to a high-priced cash crop, such as onions, which have here given returns of Sh. 800 per acre. For the present, the object is not to increase the cash turnover but rather to increase soil fertility. Furthermore, there has as yet been no sale of cattle off these farms, and in any case none of them are fully stocked. This will also provide a very large increase in the annual cash turnover, which, from data collected so far, should amount to Sh. 1,000. This seems a lot for six acres, but keeping in mind the intensive system worked and the two seasons of this area, it will be realized that this is a conservative estimate.

In arriving at these conclusions, it may help to explain one or two points. Cows are valued at Sh. 60; calves, Sh. 20 for the first year, Sh. 40 for the second year, Sh. 50 for the third year and Sh. 60 after calving; adult oxen, Sh. 60. These are well below the average local market prices for stock. Each farm must be self-sufficient as to food, and this is where estimates must be made of the value of the crops produced. A conservative figure is always taken, based on known yields. For instance, from standing field crops, a large amount of maize is used in the green stage for food. When harvesting, the yield from an untouched field is compared with the yield from a field from which a portion has been removed in the green stage, and a suitable percentage added. Then, again, the value of vegetables and fruit is not considered in the annual cash turnover at all, as it is difficult to arrive at any market figure, except for tomatoes, green peas, etc. As for poultry, only the actual sales of birds and eggs have been considered, and no figures kept for household consumption. The reason for this is that attempts to do so have produced unreliable results. Such points are, therefore, better left for a few years until some of the permanent residents can be trusted to keep improved accounts.

The same remarks apply to the consumption of milk, although here a value could be given on the known production by the various cows. In practice, figures given represent the actual sales of milk outside the farm and not the value of the total milk production, surplus to that fed to calves. The following figures show this more clearly.

In January, 1938, Farm No. 2 was stocked with two cows and a heifer, and the stock account is shown thus:—

1938 profit on stock	..	Sh. 53/76
1939 profit on stock	..	Sh. 118/76
1940 profit on stock	..	Sh. 163/70

These figures include sales of milk and the valuation, as given earlier on, for the different classes of stock. By the end of 1940 this farm had two cows, a mature heifer in calf, two two-year-old heifers and two yearlings. Actually, during 1940 the average surplus to calf requirements was five bottles a day which, valued at 10 cents per bottle, is Sh. 182/50 for the year; but only milk to the value of Sh. 65 was sold. Conservative estimates show that the value of the stock sold from such a farm at the time when it becomes necessary to dispose of the surplus every year will, together with

the total surplus milk, be at least Sh. 300 per annum after allowing for a percentage of losses.

Living costs are, again, only estimates, because it is most difficult to differentiate between necessities and luxuries. Average costs of the clerk class, when living here with their families, work out at some Sh. 250 per year, the greater part of which is expended on clothing and the least part on food such as tea, sugar, wheat flour. All the basic foods are produced on the farms. The labouring class, on the other hand, spends very little money at all, beyond an occasional few shillings for shorts or a length of material for the family.

One of the greatest difficulties experienced in trying to get the maximum out of the farms is in making the people realize the value of the right time for the various farm operations. Early ploughing and planting, so as to get early harvests and have ample time to prepare and plant the short-season crops, does not seem to occur to them. Late planting for the "short rains" often means a complete failure of those crops, whereas by planting in time good yields are obtained. The indigenous system is to prepare fields other than those under the "long rains" crops and the use of a single unit of land twice a year, although not altogether foreign to these people, is nevertheless not the rule. A comparison of a year's turnover from crops off two similar, adjacent farms well illustrates individual variation in ability to practice what we are trying to teach.

Farm (*a*), turnover on crops, Sh. 594/90; Farm (*b*), Sh. 123/43. In (*a*), the land was well worked, crops were planted early, and the tenant left the holding in a fine state, with some land under crops and some ready tilled for his successor, who took over in January. On (*b*) the tenant was late for the "long rains" season, missed the "short rains" altogether, and left the farm unkempt, with some fields unploughed and others dirty.

The Ratio of Stock to Arable

This is not a constant, as the indigenous pasture must first be improved in order to carry the number of stock required to increase and maintain the fertility of the arable. Each unit therefore starts with two to four head of cattle, depending on the carrying capacity of its grazing, which varies from 1½ head per acre to two acres per head. In all cases, supplementary feeding is provided from elephant grass (*Pennisetum purpureum*) contours, dividing up the arable into from four to seven sections, depending on the lay-out and topography.

The methods of pasture improvement or establishment tried to date have been:—

(*a*) To plant or seed grasses in a crop of maize, when near the tasselling stage.

(*b*) To plough virgin sod and plant grass directly.

(*c*) To plant grasses on old arable.

(*d*) To enrich the soil by high stock concentrations.

It is not necessary to detail here the various grass trials conducted, although a summary of conclusions may be of interest.

Method (*a*) has been a failure so far as Rhodes grass (*Chloris gayana*), *Brachiaria brizantha, Cynodon* spp. and *Paspalum dilatatum* are concerned. These were seeded. Cuttings of *Cynodon* spp. and Kikuyu grass (*Pennisetum clandestinum*) have also been tried. The drawback to seeding, or planting grass cuttings at the time the crop is sown, is that undesirable grasses are likely to obtain a very firm hold in this area of high rainfall, humidity and consequent rank growth. Couch (*Digitaria ternata*) is a pestiferous weed of cultivation here, and very soon gets the upper hand if not taken in time. Such tall-growing weeds as *Wedelia* sp. may also dominate and provide a dense shade under which desirable grasses will not thrive.

Method (*b*) is altogether satisfactory, provided the desired grasses are treated for a short period as a field crop. Excellent pasture may be established within a period of three months, when a mixture of Kikuyu and *Cynodon* is used, or pure *Cynodon* from cuttings. Provided fertility is high enough, a dense, palatable sward can be created. This is important, as *Cynodon* here will only produce a short, wiry growth on poor soil, whereas Kikuyu will not grow at all. Magnificent pasture has been established under this method, although in practice it has been found better, from the native agriculturist's point of view, to take a cash crop off the land first and plant grasses on removal of that crop. With our rapid growth and two seasons, the objection that the land is bare for a time is hardly applicable.

Method (*c*) depends, as pointed out under (*b*) above, on the degree of fertility of the soil. Seeding of grasses can only be said to be successful here on soil of high fertility and before the crumb structure is destroyed; hence their successful establishment will generally depend on a heavy application of manure.

On the other hand, *Cynodon* and Kikuyu grass can be established from cuttings provided the land has not been worked out, and there is no doubt that *Cynodon* spp. in particular are our most valuable grasses for the present. Tufted grasses are not well suited to this area, and certainly have not the carrying capacity of our stoloniferous swards; nor are they so easily established as the latter.

It may be noted that Kikuyu grass was introduced to this station about 1928, at a time when most of its 260 acres and the surrounding country was still under bush. It has since spread throughout the richer portions of the pasture. As the species occurs naturally at Kakamega, only 150 feet higher than here, with similar rainfall and climate, it is natural to suppose that it may persist here in paddocks under proper treatment. It can be made to dominate, on the lower rich lands, when planted as a pure stand, but will not dominate a mixed *Cynodon*-Kikuyu sward. Even on the shallow, ridge-top soil, where this is brought to a high degree of fertility by high stock concentrations, Kikuyu has spread naturally to such areas and forms a valuable addition to the pasture.

Method (*d*) is soil enrichment by high stock concentrations on the existing sward, i.e. the stock are confined in small enclosures within a paddock by night. Crop residues are put into the enclosure, for composting and return to the arable. The crop residues also play an important part in this method, as without them the soil is apt to be compacted and grass recovery slow. The enclosure is moved to a fresh spot every few weeks, the intervals being judged by the weather, until the whole paddock has been covered. Although this method is slow, unless a larger number of cattle are used than the farm will accommodate, improvement of the treated pasture is very marked and the change in the grass succession is rapid, the coarse grasses soon giving way to *Cynodon* and Kikuyu, with a little *Setaria sphacelata, Brachiaria brizantha, Paspalum scrobiculatum,* and a few others of less importance persisting.

With heavy controlled grazing the improved sward can be maintained at a level capable of supporting three head per acre, with supplementary feeding of elephant grass during the dry months of December, January, and usually part of February. This is a method on which a great deal more work will be done, in order to study the grass succession on the different types of soil and also the different types of natural and established swards. It is simple and involves very little labour, two operations being performed at one time, i.e. compost-making and enrichment of pasture land. As an instance of the carrying capacity of even the poor hilltop land, after improvement of the natural pasture by high stock concentrations, a quarter-acre paddock was provided for our first improved herd bull, acquired by this station in January, 1940. His paddock was made within a three-acre enclosure, wherein some 45 head of work oxen had been penned by night since 1928. By 1935 this paddock had a thick *Cynodon*-Kikuyu sward, with the *Cynodon* dominant. The quarter-acre paddock for the bull was rested for a period six weeks before he was put in. From January until July he was given no other feed than a pound of maize meal morning and evening, which he received simply for the purpose of training him to be handled by the bull boy and not as a supplementary ration. By the end of July he was in excellent condition and so was the paddock. In August he was given daily an armful of elephant grass, which is all he has had by way of supplementary feeding to date. The bull has never been out of his paddock, which has had no rest, but still provides him with a fair amount of grazing. Properly rotated and rested, such a pasture will carry its three head per acre, always allowing of course for the supplementary feed required during the three months when the grass is dormant.

Observations so far go to show that a six-acre unit requires at least 2½ acres of pasture, divided into three or four small paddocks. There is a unit here of six acres having only two acres of pasture which, together with supplementary feeding from the elephant grass contours, is supporting seven head of cattle throughout the year, but of these seven head only four are adult, the other three being yearling calves. Although the soil of the pasture is poor hilltop land, two of the cows and all the remainder of the stock have been wholly reared on this holding from 1937, and show no signs of any deficiency. This holding was started with two heifers and a cow, and the natural increase has been kept. Indications now go to show that the pasture is probably going to be insufficient next year. On the other hand over half of it is still unimproved, and certainly a long way off its maximum carrying capacity.

From data collected it appears that two head of adult stock per acre of arable should be carried on a six-acre unit. This number must include a proportion of draught oxen. As mentioned above, for the communal sharing of implements and oxen, holdings are grouped in

threes, so that no single unit should be over-capitalized in implements and draught animals. This also allows of a greater proportion of milch cows to each holding than would otherwise be possible. Furthermore, this number of cattle can effectively compost all trash from the arable, and it would appear to be the number needed to give 1 to 1½ acres of arable a fairly heavy annual dressing of compost rich in animal products.

In practice therefore, the aim is to split up the farms into roughly half arable and half pasture, the land required for house, outbuildings and vegetable garden being subtracted from the portion allocated to pasture.

Every operation and all permanent or semi-permanent farm divisions are, so far as possible, on the contour, even to paddock-dividing hedges, so that the reversion of pasture to arable and vice versa at any time will be simplified and safe.

The Nutritional Needs of the Family

The purely nutritional side of the teaching will be left to the Medical Department to deal with, and I am indebted to Dr. Harden Smith, M.O.H., Kakamega, for the following paragraphs, which show the minimum dietetic standard aimed at.

"The following scheme would give an adult an adequate and balanced diet from foodstuffs available in North Kavirondo District:—

Amount of foodstuff per adult per week—

1. Maize, sorghum, finger millet or rice: 7 lb.
2. Sweet potato, cassava, plantain or European potato: 5 lb. 4 oz.
3. Beans or peas: 1 lb.
4. Soya beans: 10 oz.
5. Meat or fish: 1 lb.
6. Milk: 2½ pints.
7. Groundnuts or simsim: 12 oz.
8. Native spinach: 1 lb.
9. Jaggery: 7 oz.
10. Fresh vegetables, fruit: As available.

For a heathy adult this is about the minimum which should be eaten in a week, particularly with regard to items 3 to 8 inclusive, the quantities of which might be increased with profit. A person doing heavy physical work would have to increase the amounts given for one or both of the first two items. The most popular of suitable increases in this respect would be that of the first item from one to one and a half pounds of grain a day.

It is important that all the items should be used, and advisable that the changes should be rung on the various foodstuffs in each item so that what is lost on the swings may be made up on the roundabouts in the matter of vitamins, salts and amino-acids. It is generally believed that calcium is deficient in nearly all African diets, but as both native spinach and finger millet contain relatively large quantities, one or both of them should be used regularly.

To estimate the amount of food required by a family, children of four may be taken as requiring half, and of eight as requiring three-quarters as much food as an adult, but the most important point in the diet of any family is that every child under five should drink at least one pint of milk every day."

In order that these recommendations may be met the farms must first produce the necessary foodstuffs and to ensure this, each farm must plant a certain minimum acreage of the various cereals, roots and pulses to provide a balanced diet throughout the year. The cereals are maize, finger millet, sorghum (*mtama*). The pulses are soya bean, native beans, cow-peas, field peas. Groundnuts or sesame can provide the oils, although to date only groundnuts have been used. Sweet potatoes and cassava plots are also required to be planted. So long as the essential requirements of these crops are planted, tenants may then concentrate on growing cash crops, such as onions, or any other that appeals to them.

The stock side is of course of primary importance. It is necessary to demonstrate the improved performance of the local stock when given proper feeding and attention, and, as stated at the beginning, to show the value of working stock and arable together, as a single, interdependent unit rather than as two separate and unrelated entities. Calf feeding and milk production are both stressed. The increased value of cereal crops put through stock, rather than sold as grain, may in time become apparent to the pupils, though it is too early yet to expect this of them.

Poultry and sheep are already established on the farms, though both are still considered sidelines, to be developed as the farms themselves evolve and take their final shape. Pigs may be introduced soon, and will certainly play an important part in time to come; but we are not ready for them yet.

(*Received for publication on 14th July*, 1941)

NOTES ON ANIMAL DISEASES

Compiled by the Veterinary Department, Kabete, Kenya

XII—CALF DISEASES

Introduction

The diseases of calves may be divided into four groups according to their etiology. The first group contains those caused by protozoal parasites, the second those caused by bacteria, the third those primarily due to errors in feeding and the last those whose etiology is still obscure. In some countries worm infestations are occasionally responsible for mortality in calves. In Kenya, however, although calves do harbour worms, they rarely suffer severely as a result of the infestation.

Of the protozoal diseases redwater, anaplasmosis and east coast fever have already been described. In ranched calves redwater and anaplasmosis are of little significance and even in hand-fed calves the reactions to these diseases are usually exceedingly mild. Trouble may, however, arise when hand-reared calves are kept in houses under tick-free conditions for several months and are later turned out on heavily infected pasture. The younger the calf, the less severe is likely to be its reaction. Hence the best method of preventing severe reactions when the calves are turned out is to inoculate them in monthly batches, when 2–6 weeks old, with the first redwater-anaplasmosis "vaccine". East coast fever in heavily infected areas is one of the main causes of calf mortality. It can only be controlled by eradiction of the vecting ticks by dipping and hand-dressing. One other protozoal disease is sometimes responsible for losses in calves, coccidiosis. This will be described shortly.

Of the bacterial diseases there are quite a number. Navel ill, as the name implies, is due to infection entering at the navel before the cord becomes dry. The disease may be caused by a variety of organisms. There are two bacteria of the *Salmonella* group which cause specific diseases and in addition calf diphtheria and haemorrhagic septicaemia, the latter a disease which may affect cattle of all ages but is most frequently seen in calves.

Colon bacillosis is primarily due to errors in feeding; but might with some justification have been included in the previous group. The group of bacteria grouped under the old name, *B. coli*, are normal inhabitants of the posterior parts of the alimentary tract. When owing to digestive disturbances, these bacteria move forward into the more anterior portions of the gut the disease colon bacillosis or white scour occurs. At the same time the organism increases in virulence and infection is likely to spread to other calves.

Of the diseases of unknown etiology two important conditions fall to be described, sweating sickness and calf pneumonia.

Thus the number of calf diseases with which the farmer has to contend is large. Fortunately, however, strict attention to hygiene and feeding will go far to prevent the occurrence of most of them.

Coccidiosis

The coccidia are a group of unicellular animal parasites which live in the intestinal or gall-duct walls of animals. Coccidiosis is probably better known to poultry- and rabbit-keepers than cattle-owners for diseases caused by members of the group are more common in these small animals. Coccidia, however, occur in most animals and some species have been described from man.

Like most protozoal parasites the coccidia are host-specific, that is to say a species occurring in, for example, a fowl will only infect closely related birds like the pheasant. The same parasite will not infect a duck. The two rabbit species are quite harmless to cattle and while some of the dog species have been found in cats they also are quite incapable of infecting cattle.

The classical parasite of cattle is *Eimeria zurni*. The species found in cattle in Kenya differs somewhat from *E. zurni* and has probably never been described.

Occurrence.—In Kenya the disease coccidiosis is rarely seen in cattle other than young calves except when breakdowns occur following the use of goat vrius for immunization against rinderpest. The oöcysts are, however, frequently found in the routine examination of fæces for worm eggs and it is probable that the majority of adult cattle harbour the parasite.

Life History.—The parasites persist outside the animal body as small egg-shaped or oval bodies called oöcysts. These bodies have a hard shell which enables the eight, contained

sporozoites to survive a reasonable amount of desiccation.

When the oöcysts are swallowed, the shell is dissolved by the digestive juices and the minute parasites are liberated. They penetrate into cells of the wall of the large intestine where they grow and divide. After one or two asexual cycles, male and female types of cell are produced. These unite and the body so produced develops into an oöcyst. This is passed out in the fæces and after a period of ripening is capable of infecting other animals.

Symptoms.—Coccidiosis is characterized by diarrhoea and dysentery. The fæces are usually very characteristic as they contain either flakes of mucus containing blood or small pieces of blood clot. The course of the disease is chronic and in the later stages the animal loses condition rapidly. The temperature rarely rises above normal.

Post-mortem Lesions.—These are usually confined to the large intestine which shows patches of severe ulceration partially covered with yellowish, necrotic mucous membrane.

Treatment.—A number of remedies have been recommended for the treatment of coccidiosis in calves, the majority being used locally in the form of enemata. Unfortunately few of them are really effective and most of them are too expensive for general use.

Reasonably good results are usually obtained with the following prescription: Thymol 15 grains, burnt iron alum ½ drachm. Two to six powders should be given daily according to the size of the calf.

Prevention.—As coccidiosis can only be spread by the fæces of other calves, the disease should be controlled by strict attention to hygiene. The oöcysts survive longer under moist conditions, so that the greater danger lies in damp spots and in contaminated drinking water. Coccidiosis has been diagnosed in hand-reared calves living in concrete-floored boxes. Infection in this case was probably brought in with grass used for bedding. The grass had been cut close to the cow-house and from its lush appearance it was obviously from a heavily-manured, shady place.

Navel Infection

Septic infection of the navel within a few hours of birth is a condition most frequently observed during wet weather among calves which sleep in "bomas" or dirty houses. The infection may be a variety of organisms of which *Fusiformis necrophorus,* streptococci, *B. coli* and *Corynebacterium pyogenes* are frequently encountered.

The symptoms vary greatly depending on the site at which the invading organisms have been localized. There may or may not be an outward swelling at the navel and swollen joints (joint-ill) are less common in calves than in foals and lambs. After death, abscesses or necrotic spots may be found in the lungs or liver. In most cases a small abscess or necrotic area can be found if the umbilicus is cut through with a knife and this lesion gives the clue to the cause of death. Occasionally infection spreads up the urachus to the bladder, where pus may be found.

In cases where an abscess is visible externally at the navel, this should be opened and dressed with a disinfectant solution. The disease may be prevented by tying the cord with clean string close to the abdominal wall at birth, cutting the cord off with a clean knife and dressing the ligatured stump with tincture of iodine.

Calf Diphtheria

Calf diphtheria is the name given to a specific disease of calves caused by *Fusiformis necrophorus* and characterized by the presence of yellow necrotic ulcers in the mouth. The disease is more frequently seen in hand-reared than in ranched calves, but occurs occasionally in the latter during wet weather.

The organism, *Fusiformis necrophorus,* is a dirt organism which thrives in damp manure and decaying vegetable matter.

Symptoms.—When the lesions are in the mouth, affected calves salivate and show unmistakable evidence of a sore mouth. If the mouth is opened, yellow patches of cheesy material are found on the tongue, hard palate, gums or on the inside of the cheek. Lesions inside the cheeks often produce swelling of the side of the face.

Cases of calf diphtheria are not uncommon in which lesions are confined to the throat and coughing and difficulty in swallowing may be the only symptoms. Occasionally also cases are seen in which lesions are restricted to the rumen. More frequently lesions in the rumen are secondary to lesions in the mouth and throat. Secondary lesions may also occur in the lungs and liver.

Diagnosis.—The appearance of a bacillary necrosis lesion with its thick yellow, cheesy

surface is very characteristic. The organism is present in great numbers in the deeper parts and the diagnosis may be confirmed by making smears from the material next to the healthy tissue and submitting them to the laboratory for examination. The organism may, of course, invade old ulcers primarily due to foot and mouth disease.

Rinderpest ulcers differ from those of bacillary necrosis in being smaller and more scattered and in having a much thinner layer of necrotic material overlying them.

Treatment.—Accessible lesions in the mouth should be scraped with an old teaspoon and dressed with tincture of iodine.

Valuable animals may be treated with M. and B. 693; 4g. should be given as an initial dose, followed by not less than 2g. three times a day for three–five days.

Bacillary necrosis may be prevented by careful attention to hygiene. Feeding buckets used to hand-feed calves should be well sterilized by boiling or, when this is not possible, by a solution of chloride of lime. Calf pens should be disinfected with chloride of lime. Whitewash, although it enables the owner to see how soon a pen becomes soiled, is not an efficient disinfectant.

When calf diphtheria occurs in ranched calves in wet weather, infection is usually contracted from the teats of the cow soiled as a result of lying in a dirty *boma.*

Calf Paratyphoid

Calf paratyphoid is a specific disease of calves caused by the organism *Salmonella enteritidis dublin.* It is more frequently seen in ranched or dairy-ranched calves than in hand-reared calves, although severe outbreaks in the latter are occasionally encountered. Calf paratyphoid is peculiar in that outbreaks are usually restricted to calves between the ages of six weeks and three months, but cases outside this age range may occur.

Symptoms.—During the early stages the calves are dull and run a temperature. Appetite is lost and the calves are constipated. Later diarrhœa sometimes appears, the fæces being dark in colour owing to the presence of blood charged by passage along the gut. In ranched calves death often occurs suddenly and the disease is very often complicated with anaplasmosis and redwater.

Post-mortem Lesions.—The most characteristic lesions found in paratyphoid are the swollen, mottled-purple liver, the enlarged spleen and the swelling and congestion of the kidneys. Some cases show so-called "turkey-egg" kidneys, the surface of the organs being mottled like the shell of a turkey egg. In addition thickening and patchy congestion may be present in the intestines and the mesenteric lympatic glands (the round or elongated bodies in the "skirt" about four inches from the gut) are swollen, moist on section and sometimes haemorrhagic. When death occurs at a late stage there is sometimes pneumonia.

Diagnosis.—A definite diagnosis of an actual case can only be made if a bacteriological examination is possible. Small pieces of liver and of mesenteric lymphatic gland should be removed as cleanly as possible and as soon after death as possible, and sent to the laboratory in a small jar that has been sterilized in boiling water and allowed to cool. No preservative should be added. The organism can also be isolated from the fæces of a sick calf; but, in view of the variety of organisms present in fæces the isolation takes much longer and diagnosis is less certain.

Recovered cases can be detected if a sample of blood is sent for the agglutination test. The blood should be collected from the jugular vein in a sterile bottle and the nature of the test required should be specified.

Treatment and Prevention.—No satisfactory medicinal treatment has yet been evolved. The disease may be prevented by vaccination, the vaccine being inoculated for preference when the calves are about 14 days old. Like all bacterial vaccines paratyphoid vaccine does not produce an absolute immunity. During an outbreak, therefore, vaccination should be accompanied by strict attention to hygiene. From its real relationship to human typhoid one would expect that some recovered animals might act as carriers. The concentration of ranch-dairying milk cows and their calves on small areas should be avoided. Calves should not be allowed to stand about on fouled places near the milking bails nor should hand-fed calves be allowed during the day to graze around the cow house drains where the grass is usually green.

Tick-borne disease frequently complicates paratyphoid in ranched calves and mortality may often be checked by the institution of regular dipping.

The carcasses of calves that have died of paratyphoid should always be burnt or buried. Cases of food poisoning have occurred in Kenya both in dogs and in human beings from the consumption of meat from calf-paratyphoid cases.

Salmonella Typhi-Murium Infection

This disease is caused by an organism of the paratyphoid group which is pathogenic for most mammals and birds and is one of the commonest causes of food poisoning in man.

Cases in calves may occur between the ages of seven days and four months.

Symptoms.—In very young calves the symptoms resemble those of white scour and in older calves those of paratyphoid.

Post-mortem Lesions.—In older calves the lesions are identical with those of calf paratyphoid and the two diseases can only be separated by a bacteriological examination. In young calves in addition to the paratyphoid lesions in the liver, kidneys and mesenteric glands, a characteristic change is found in the large intestine, most constantly in the caecum. This change consists of patches of yellow-white necrosis of the mucous membrane. Sometimes the whole of the caecum and much of the rest of the large gut is involved. At other times numerous small discrete spots or isolated patches are observed in the caecum and occasional small areas, or nothing at all, in the colon and rectum. Such lesions are never seen in true white scour and are more likely to be confused with coccidiosis.

Diagnosis.—The same methods of establishing a diagnosis as in paratyphoid are employed.

Treatment and Prevention.—A strain of *Salmonella typhi-murium* is included in the *B. coli* vaccine and this vaccine should be used at birth. Other methods of hygienic control should also be adopted, strict attention being paid to the cleanliness of milk buckets and calf pens. Calves should not be allowed to congregate on land fouled by older stock.

Haemorrhagic Septicaemia

Diseases due to organisms of the *Pasteurella* group occur in cattle, sheep, pigs, rabbits and poultry, the organism being named after the animal from which they originate, thus *P. boviseptica* from cattle, *P. suiseptica* from pigs, *P. avicida* from fowls. By bacteriological methods there is great difficulty in differentiating strains isolated from different hosts and it is possible that they are only forms of one bacterium. The organism causing plague in man also belongs to the *Pasteurella* group.

Although haemorrhagic septicaemia occurs in most countries of the world from the arctic regions to the tropics, the common form of the disease in different countries varies. In many parts it is an acute, fatal septicaemia liable to be confused with anthrax. In Kenya this acute, septicaemic form is exceedingly rare and appears limited to calves under three days of age. In older calves and in adults the disease is found in the sub-acute form and is usually mistakenly called "snake-bite".

Symptoms.—In the acute form death is sudden and no symptoms are observed. In the sub-acute form the disease is characterized by a large swelling of the throat, head, brisket, one of the limbs or the root of the tail. Cases in calves when the whole head is swollen have been named very appropriately "hippopotamus head". On cutting the swelling it is found to be due to infiltration of the tissues by a straw-yellow, gelatinous substance and a yellowish, sticky fluid exudes from the cut. Death usually occurs within 24–48 hours.

Post-mortem Lesions.—The name haemorrhagic septicaemia is derived from the haemorrhages found *post mortem*. They are most marked in the typical, acute cases and are much less constant in the locally more usual, sub-acute ones. They are found on both surfaces of the heart, on the external surface of the stomach and other organs and inside the intestines. The rectum may show zebra markings as in east coast fever and other diseases.

Diagnosis.—In acute cases the organism is present in blood smears; but in order to be certain of obtaining a satisfactory diagnosis, a sample of blood of an acute case, or of fluid from the swelling of a sub-acute case, should be sent in a sterile bottle without preservative (or with a little citrate solution) to the laboratory. This sample is required for the inoculation of mice which, if the sample is positive, die within 24 hours and show a typical *Pasteurella* septicaemia.

Transmission.—Experiments at Kabete have shown that haemorrhagic septicaemia may be transmitted among calves by fleas. In other countries transmission among adult animals is believed to be through the agency of various arthropods; mosquitoes, midges and ticks have all been blamed.

Treatment.—No specific medicinal treatment has been discovered. An experimental vaccine issue from Kabete appears to be successful in curtailing most outbreaks; but may fail in the case of very young calves, if the pens are heavily infested with fleas.

White Scour

As has been mentioned in the introduction, white scour is primarily a disease caused by errors in feeding, for the types of organism which actually cause death are normal inhabitants of the intestinal tract. Feeding too large a quantity of milk is as potent a factor in producing this condition as feeding too little. Other factors are feeding the milk too cold and feeding at irregular intervals.

Once a primary case has occurred the disease spreads as a contagious disease and very strict attention to cleanliness is necessary to check an outbreak.

Symptoms.—White scour is a disease of very young calves, cases rarely starting after the age of 12 days. The typical white or yellowish fæces have a characteristic smell and the disease cannot be mistaken for any of the other diseases of calves except *S. typhi-murium* infection. Recovered calves are often unthrifty. They grow slowly, remain in poor condition and may develop a chronic cough.

Post-mortem Lesions.—This disease is usually much easier to diagnose during life than after death, when very few pathological changes can be found in the internal organs. Some thickening and patches of slight inflamation may be present in the small gut and the mesenteric lymphatic glands may be swollen and moist.

Chronic cases may have abscesses in the kidneys, lungs or other organs.

Treatment.—A drug known as sodium tellurite has a specific lethal action on organisms of the *B. coli* group. This drug may be obtained from Kabete with full instructions for use.

It is a good plan to withhold milk completely for 24 hours and to give the calf in its place a thin gruel made of flour or posho. In making the gruel the starch in the flour or posho should be "turned" in the same way as starch is prepared for laundering.

The calf pens should be thoroughly cleansed and disinfected and in order to prevent spread at feeding time the healthy calves should be fed first and the buckets disinfected between each calf. Hand-fed calves should be penned individually so that they cannot suck each other and sick calves should be groomed several times a day in order to reduce the amount of infection in the house.

A vaccine called *B. coli* vaccine containing a variety of calf disease organisms is issued by the Kabete Laboratory for the inoculation of calves at birth. This vaccine is not expected to be of great value in the control of colon-bacillosis, against which disease it is not possible to prepare a satisfactory vaccine. It is issued because some farmers demand it and because it is of value in the control of *Salmonella typhi-murium* infection.

Contagious Calf Pneumonia

Contagious calf pneumonia is a disease that occurs in many parts of the world and the etiology of which, in spite of much research work, is still obscure. It is characterized by a rather typical pneumonia from which the organism *Corynebacterium pyogenes* can usually be isolated. Attempts to reproduce the disease by inoculating this organism by a wide variety of routes have, however, proved unsuccessful. Although by vaccinating calves with a vaccine containing *C. pyogenes,* the incidence of the disease is frequently somewhat reduced, cases of the disease may still occur and from some of these it may not be possible to isolate *C. pyogenes.* Other bacteria, usually slow-growing, gram-negative rods are obtained; but these organisms are rather variable in their characters and with them also it has, so far, not been possible to reproduce the disease.

Calf pneumonia is a disease of hand-reared calves, usually of calves housed in permanent quarters. Experience with the disease in Kenya suggests that although calves may not develop symptoms until they are 3–4 weeks old, or even later, infection is contracted during the first 12 days of life.

Symptoms.—Affected calves show a more or less watery discharge from the nose and some lachrymation. They stand with the forefeet in a forward position as if to relieve pressure on the chest and the breathing is shallow and rapid. In some cases during the eary stages, a peculiar form of diarrhoea is observed, the fæces being of the consistency of mixed cement and pink or even orange in colour. The temperature is elevated and sweating may be noticed. Death usually occurs after an interval of several days.

Post-mortem Lesions.—The anterior lobes and the anterior part of the main lobe of the lungs is found to be solidified and red or red-grey in colour. On cutting with a knife the diseased parts cut like liver and the cut surface is red or red-grey mottled with yellowish spots. Parts of the surface of the affected lobes may be covered with a rough, yellow veil of deposit and a similar lesion may be found on the opposed part of the chest wall.

Marked lesions are not usually found elsewhere. When in addition to the lung lesion abscesses or necrotic lesions are found in the liver and kidneys, it is more probable that death was due to navel infection.

Treatment and Prevention.—Valuable calves may be treated with M. & B. 693, the dosage being the same as that recommended for bacillary necrosis.

In controlling outbreaks the experimental *Corynebacterium pyogenes* vaccine has given good results on some farms; but on others has only checked the spread of the disease temporarily. There appears to be only one way of stopping the disease completely and that is to place new-born calves in individual portable huts in a clean paddock and to move the huts daily to fresh ground. The calves should be kept in these quarters until they reach the age of 14–20 days, when they may be placed in the ordinary calf house.

Sweating Sickness

The disease sweating sickness appears to be confined to the continent of Africa, south of the Sahara. It affects calves from 2–6 months of age, occurring under both ranching and hand-rearing methods of management. In Kenya the disease is most prevalent towards the end of long spells of hot dry weather. It does not occur in the relatively cold, Kikuyu grass areas.

All attempts to transmit the disease from sick to healthy calves, both at Kabete and in South Africa, have failed. At Kabete experiments have suggested that the disease is nutritional in origin; but further work is necessary to confirm this and to determine what factor is responsible.

Sweating sickness normally has a mortality rate of 50–80 per cent.

Symptoms.—The typical symptom of profuse sweating along the sides of the neck and flanks is best observed in the early morning. During the period when most of the cases occur, the hot sun dries the sweat and later in the day only a matting of the hair may be seen. During the later stages in severe cases, hair is lost and necrosis and ulceration are commonly observed in the arm pits and between the hind legs.

In addition to sweating other symptoms are usually present. At the beginning of the illness the temperature is usually high and lachrymation, salivation and a running nose frequently occur. On opening the mouth the inside appears unduly red in colour and this may pass on to patches of ulceration in the mouth and throat at the time of death. The upper surface of the tongue feels abnormally smooth owing to loss of papillae.

Post-mortem Lesions.—Typical cases of sweating sickness show no naked-eye *post-mortem* signs other than those recorded under the heading of symptoms. Occasionally delayed cases die of a secondary pneumonia, the lungs appearing similar to those of a case of contagious calf pneumonia. A calf which dies of uncomplicated sweating sickness, however, shows no abnormality in the lungs.

Treatment.—If taken in time, uncomplicated sweating sickness has been found to respond to the administration of a crude liver extract similar to the original extracts used in the treatment of human pernicious anaemia. Affected parts of the skin should be washed with warm water and dressed with an emollient dressing. Severe excoriations in the arm pits and under the tail may need special attention to prevent infestation with maggots.

YELLOW BEAN MOSAIC AND NOTES ON OTHER BEAN DISEASES

By G. B. Wallace, B.Sc. Agric., Ph.D. (Edin.), Plant Pathologist, Department of Agriculture, Tanganyika Territory

In an account of French bean diseases previously published in this Journal [1] common bean mosaic was described. There is now evidence that a yellow bean mosaic is also present in Tanganyika Territory.

Pierce [2] has described a yellow mosaic of French beans in the United States of America, but no record of its occurrence elsewhere has been found in the literature available. The Tanganyika disease resembles this in symptoms, but the identity of the two diseases remains uncertain. Confirmatory experiments are planned to decide the question.

On account of their resistance to common mosaic, certain varieties were imported from the U.S.A. and sown at Lyamungu. The reputation for resistance to that disease has been maintained under our conditions. They are reported to be only slightly susceptible to the yellow mosaic of America but here all but two were so severely attacked by a yellow mosaic as to rule out any possibility of growing these otherwise useful varieties in this area.

The yellow mosaic of America cannot be carried in the seed, and therefore it can be concluded that that disease was not introduced with the imported seed. If the Tanganyika disease is the same as the American, it must have been already present in the territory. If, however, it is different, no conclusions can be drawn; but it seems unlikely that, if it is seed-carried and introduced from America, it would be so mild there as to have been undiscovered in the investigations made by Pierce. No yellow mosaic has been seen in any of the many other varieties grown. The present supposition is that it has been present in one or more varieties, carriers, which are infective without showing disease symptoms. The varieties commonly grown, such as Canadian Wonder, Rose Coco and others, are apparently unaffected.

There is a possibility that yellow mosaic may be of more importance in French beans in other areas of East Africa, and also that varieties imported may show susceptibility as was found here. For these reasons a few diagnostic characters are given below for reference. Yellow mosaic was severe at Lyamungu in the following: Wisconsin Refugee, Idaho Refugee, Red Wisconsin U. 1.3 and U. 1.34, Great Northern U. 1.1, U. 1.59, U. 1.81 and U. 1.123, and Robust. Refugee U.S.1 and U.S.5 showed only light infection. Among others several Virginian varieties were free from the disease.

Not all of the diagnostic characters described by Pierce have so far been seen in the local disease, but the tendency for some leaves to become concave, as seen from the upper surface, is fairly constant in affected plants. That character and the greater degree of yellowing serve to distinguish the yellow mosaics, particularly in the later stages, from common mosaic. In the latter many of the leaves are concave on the lower surface, i.e. they are cupped downwards.

Early symptoms of the American yellow mosaic are said to be the development of small light yellow spots on the dark green background of the first trifoliate. This yellowing gradually spreads, causing the leaflets to become chlorotic, and becomes more pronounced as the season progresses. It will be noticed how yellowing in one form or another is associated with most bean diseases, but these need not be confused.

In common mosaic the leaves are more curled and contorted, and there is a tendency for the leaflets to be reduced in size compared with the leafstalks. Both the yellow and common mosaics cause the plants to become stunted and unproductive.

Notes on Other Bean Diseases

A trouble with sun-scorch symptoms was prevalent in Kilimanjaro bean fields in 1940; a premature drying-up of the plants resulted in many unfilled pods and small seeds with the full colour undeveloped.

The following symptoms suggested the cause to be sun-scorch or other adverse weather conditions. The trouble started when the plants were half grown. The veins of the leaflets remain green, but the tissue between becomes yellow and etiolated. Brown areas develop on the yellow, and when seen from a distance the plants look yellow or brown. Plants sown later in the season were less affected. Although few of these yellowed plants showed typical bacterial disease symptoms in the leaves, the rather large percentage of seeds showing the characteristic orange-coloured blisters seems to indicate that this may to some extent account for the trouble.

The pest, bean fly, which can be severe to the extent of causing 100 per cent loss of crop in the short-rains sowings about November, is insignificant in the main crop. In 1940 many varieties sown in June (a little later than usual) showed a small percentage infested when they were about six inches to one foot high. Areas are, however, known where beans may be safely sown with the short rains. The pest was again seen in cowpeas, in August.

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REVIEW

REPORT BY MR. J. SMITH, O.B.E. (ADVISER ON ANIMAL HEALTH TO THE SECRETARY OF STATE FOR THE COLONIES) ON HIS VISIT TO EAST AFRICA, April–July, 1941.

This report, published by the Colonial Office as Colonial Agricultural Council Paper 558, runs to 32 pages. Mr. Smith's itinerary included visits to the Veterinary Laboratories of the three East African territories, a tour of six days in Kenya, and a similar tour in Uganda. The remainder of Mr. Smith's time was spent in Tanganyika Territory, much of it being devoted to a study of the rinderpest position in the South.

The section of the report that deals with Kenya occupies some 13 pages. It is proposed to deal first with the Kenya section, and to follow this with a summary of the Uganda and Tanganyika sections.

In commenting on the organization of the Veterinary Research Laboratory, Kabete, Mr. Smith refers to the choice of the Kabete Laboratory as the home of the Central Veterinary Research Institute for East Africa and discusses the position that has arisen from the housing of the Kenya Research Laboratory, the Central Research Institute and the Administrative Headquarters of the Kenya Department in the one building. He remarks that after the war when the Central Veterinary Research Institute comes into full operation it may be desirable to remove the Kenya Laboratory staff to separate quarters and to appoint a whole-time independent Director for the Central Veterinary Research Institute. In Mr. Smith's view the duties of the present Director, who is also Director of Veterinary Services, Kenya, are too extensive and make excessive demands on the time of one who is engaged in the direction of research. He suggests that as soon as circumstances permit "the Administrative Headquarters should be removed from the laboratory and housed in a separate building either in Kabete or Nairobi, and the duties of the Director be limited to those normally performed by the head of a department."

Not everyone will agree entirely with this recommendation. The purpose in moving Veterinary Headquarters to the laboratory at Kabete was not wholly, or indeed even primarily, that of economy; the proposal had in fact been made on more than one occasion before Sir Alan Pim finally recommended the separation of the Kenya Agricultural and Veterinary Departments. The view was generally held that research in Kenya was outstripping its practical application in the field, and that both in field work and the direction of policy the department would gain much from a closer association with laboratory services and research, and from direction by a research worker of experience. If this arrangement has made inroads on the time that the Director would normally be able to devote to research, there may have been compensatory advantages in the infusion of new ideas and possibly new enthusiasm into the work of officers in the field. It is perhaps significant that of the departments engaged in comparable work, the two generally regarded as the most efficient, the Bureau of Animal Industry, U.S.A., and the Department of Veterinary Services, Union of South Africa, both have their administrative headquarters housed in the same building as the main laboratory services, and in the second case the Director is a research worker of international repute. In the direction of a colonial veterinary department, where almost every major problem of policy has in it some of the elements of a research problem, it seems that considerable advantage may be derived from the close association of research and administration that is effected by such an arrangement.

WEEVIL DAMAGE TO STORED GRAIN

By H. Wilkinson, A.R.C.Sc., F.R.E.S., F.L.S., Senior Entomologist, Kenya

In the present state of emergency and with the necessity for increased production of grain, especially wheat, it is the national duty of every person handling wheat and other grain to see that this grain is kept free from weevil attack and so prevent loss in storage.

Where does this weevil trouble start and how can it be avoided? These are natural questions which may be asked by farmers and others intimately concerned with production and storage, and who have little knowledge of the habits of weevils. Contrary to the general belief, if clean wheat is harvested with clean machinery, bagged in clean bags and stored in buildings which are free from weevils and free from outside contamination, it will remain free from weevil attack for an indefinite period. Unfortunately such a state of affairs is seldom found in actual practice and infestation occurs at one or more points of handling.

Grain in the Field

Under Kenya conditions it is a very rare occurrence for weevil infestation to take place in the field except in grain growing near to a maize crib or other place near to where grain or meal has been stored. Thus in most cases within the Colony it is possible to harvest clean and uninfested grain provided clean machinery is used.

The condition of grain at harvest time is also of vital importance with regard to its future storage. It is a well known fact that damp or wet grain is very prone to weevil attack, while grain well matured and dried is very resistant to attack. It is therefore recommended that farmers allow their grain to ripen thoroughly and to mature and dry out before being harvested. Wheat should not contain more than 10 per cent moisture and maize not more than 12½ per cent before bagging or placing it in the crib. Under no circumstances should grain leave the field in a slightly immature or green condition. Such a practice on the part of the farmer may well cause serious losses to other grain stored with the immature sample.

Harvesting Machinery

Unless grain in harvesting machinery is thoroughly cleaned out immediately after harvest or prior to the new harvest it may constitute a serious infestation of clean grain from the field. Thus the maize sheller should be thoroughly examined and cleaned out before shelling the new season's crop and shelling should not take place near the old maize crib as is the usual practice in this country. With wheat machinery such places as the threshing drum, the elevator belt and cups and the bottom of the elevator should receive particular attention. As additional grain and dust will be shaken out from the cracks and crannies when the machine starts, it should be run for a few hundred yards and then re-cleaned before entering the new crop.

Grain and Meal Stored on the Farm

Seldom is the maize crib on the farm free from weevil.

Also on the majority of farms certain quantities of wheat, barley or oats, bran and pollard, are stored for purposes of poultry or stock food. Contamination of the new season's crop may take place from these sources.

Before harvesting the new season's crop all loose grain in and around the maize crib should be swept up and burned and the crib thoroughly sprayed with paraffin or crude oil, old engine oil will do, though this is messy, paying particular attention to all cracks and joints in the floor.

If the new season's wheat has to be stacked on the farm for any length of time before being delivered, it should be stored as far away as is practicable from grain or meal stored for poultry or stock food.

Treatment of Bags

Wherever possible the new crop should be delivered in new bags. If this is done one serious source of infestation of otherwise clean grain will be eliminated. It is fully realized that for various reasons this is not always possible. If second-hand bags are used they should without exception be treated prior to use as these are liable to contain weevils.

If there is any reason to suspect that these bags contain weevils they should be heat treated as follows:—

(*a*) Turn the bags inside out and dip them in boiling water for a period of five to ten minutes. This will destroy all stages of the weevil and cause only slight shrinkage of the bags. An old forty gallon oil or petrol drum

is very suitable for this operation. After treatment the bags should be hung out to dry.

(*b*) Fumigation of the bags with carbon-bi-sulphide can also be satisfactory, though it is realized that it is difficult under the present conditions to obtain this material. If farmers possess this material the bags can be fumigated by using some suitable receptacle such as a corrugated iron tank or empty oil drum; pack in the bags and pour carbon-bi-sulphide on to the top layer, using the material at the rate of eight pounds per 1,000 cubic feet. For a forty gallon drum one ounce of carbon-bi-sulphide is sufficient and for a 1,000 gallon tank 1 lb. will be required—a gallon of carbon-bi-sulphide weighs 13 lb.

After closing the top of the drum or tank as thoroughly as possible, fumigation should proceed for 48 hours. The bags should then be taken out and thoroughly aired. Carbon-bi-sulphide being explosive, one should be most particular to see that no naked lights of any description are present during fumigation, and smoking should be prohibited.

Summary

(1) Do not harvest until all the grain is ripe. The presence of any "green" or immature grain may cause serious loss in storage.

(2) Thoroughly clean out all harvesting machinery and maize shellers before using in order to remove the first source of weevil infestation.

(3) Thoroughly clean out and disinfect all maize cribs or stores to be used for the new season's crop.

(4) Keep the new season's crop well away from wheat, maize, barley, oats, bran, pollard or posho stored on the farm.

(5) Use new bags if possible. If second-hand bags are used they should first be adequately treated for the destruction of weevils which may be present.

The above are practical suggestions which if carried out on the farm will help considerably to reduce weevil infestation at the source.

(*Received for publication August,* 1941)

IMPORTANT NOTICE TO SUGAR CANE GROWERS

A number of sugar cane varieties are now available for distribution to growers. These varieties have been imported from overseas, passed through the Central Quarantine Station at Amani, and tested in the field by the Plant Pathologist, Department of Agriculture, Uganda. Cuttings will be supplied at the cost only of packing and transport, and the available material will be divided among those who apply before December 1st 1941. All applications should be addressed in the first place to the Director of Agriculture of the country in which the applicant is resident.

The varieties now offered have been selected from a larger number that have passed through quarantine, others having been rejected for various faults. The fact that these varieties are now recommended implies no more than that they have not shown any outstanding faults. It is not suggested that any are better than existing standard varieties, but only that they are worthy of trial by any growers who wish to increase their range of available varieties. The varieties in Class (2) are liable to contract mosaic disease but suffer very mild effects; it is important, however, that they should not be introduced into any area where mosaic is not known to exist already.

The following are the varieties offered:—

Class (1).—Recommended for general trial.

B. 34106
B. 34123
B. 34129
B. 35179

Class (2).—Recommended for trial only in areas where mosaic disease is known to exist.

B. 3337
B. 34120
B. 35151
B. 35221

A USEFUL PASTURE POLICY*

The fear of a shortage of nitrogenous fertilizers on the part of some farmers is bound to have repercussions on the development of pasture farming in the Union.

A grass which is grazed down several times throughout its growing season requires a great deal of nitrogen, much more than a grain, hay or silage crop. It is for this reason that in the fertilizing of pastures the necessity of adequate dressings of nitrogen, apart from phosphate, potash, and possibly lime, is emphasized.

The quickest acting forms in which to apply the nitrogen are sulphate of ammonia, nitrate of soda, and nitro-chalk, but owing to the present international situation it may be difficult to obtain these fertilizers in sufficiently large quantities. There are, of course, substitutes for these forms of nitrogen, such as animal manure, compost, blood meal, bone meal and certain pasture-fertilizer mixtures. These, however, have to be applied in large quantities in order to meet the nitrogen requirements of intensive pasture, and in the case of blood meal and bone meal this may make fertilizing a very costly business.

It is just as well to prepare for the possibility that for some time to come pasture farmers will not be able to obtain the nitrogenous fertilizers which they ordinarily require.

One way of getting along would be by resorting to row-planting of pastures which lend themselves to that method of establishment. By spacing the rows fairly wide apart it will become possible to cultivate the pasture and thereby a certain amount of nitrogen will be liberated from the organic matter in the soil, from the dung of animals, and decayed parts of the pasture plant. The amount of nitrogen thus placed at the disposal of the grass may be small, but it will be extremely valuable. In conjunction with a dressing of manure, compost, or a pasture fertilizer, it may well prove sufficient for the production of a considerable quantity of nutritious grazing.

A grass pre-eminently suitable for this method of planting is Napier fodder. Climatically, this upright perennial cousin of Kikuyu prefers a long, warm growing season. It will therefore thrive best in the low veldt and the lower middle-veldt, but at the same time will given good results also at higher altitudes, provided frosts are not too severe. Amongst the different kinds of soils it prefers the light type. This accounts for the fact that even on the windswept sands along the coast, Napier fodder is proving very successful. Good drainage and depth of soil so that the roots can penetrate deeply are very important factors and for that reason medium to heavy soils often give disappointing results.

Napier fodder can be found on many farms, but its value as a cheap, bulky and nutritious feed has seldom been recognized hitherto. The grass is often planted on contour banks or in strips across slopes for the control of soil erosion. There it is generally allowed to grow as tall as it can, and animals have access to it only during autumn and winter when the stalks are woody and the leaves hard and unpalatable. Small wonder therefore that stock do not like the grass in that condition and do not thrive on it. A totally different state of affairs is encountered where Napier fodder is fed in the young stage. Then all kinds of animals take to it greedily and owing to its high protein content its feeding value leaves nothing to be desired.

The utilization of Napier fodder as a pasture is a comparatively recent innovation. Previously, if its value was realized at all, the general practice was to "soil" the grass, i.e. to cut it and feed it off the field. "Soiling" has certain advantages, but the greatest disadvantage of this practice is its cost. Pasturing is not only the cheapest method of harvesting, but also permits of the retention of plant food in the form of dung and urine on the land where the grass grows. For grazing purposes, Napier fodder should be established in rows four to five feet apart, with a spacing of approximately one foot between the plants in the rows. Wide rows are necessary to facilitate cultivation and to prevent the grazing animals from injuring the grass stools through tramping on them. On the other hand, close spacing in the rows is a safeguard against weed impenetration. Weeds in between the rows can easily be dealt with by cultivation, but in the rows they often become a nuisance and are difficult and costly to eradicate.

It is remarkable how Napier fodder changes its habit of growth once it is grazed. Instead of producing a few strong upright stems, as it would if not interfered with, it sends out a multitude of soft, palatable side-shoots which give the plant a spreading appearance. It is due to this characteristic that the rows have to be wide apart.

* W. Schultz, *Farming in South Africa*, Vol. XV, No. 169, p. 131, 1940.

Planting material consists of roots or stem cuttings. Roots give the best and quickest results, but their establishment entails more work and expense because they have to be dug out and furrows or holes have to be made before they can be planted. Stem cuttings are cheaper to obtain and cheaper to plant. Mature stalks or stalks which have already become fairly hard are cut down and divided into sections containing at least three nodes. These are inserted into the prepared soil in such a way that two nodes are buried and one remains exposed. From these nodes the roots and shoots of the new plant develop.

The best time to establish Napier fodder is from spring to mid-summer, depending on the availability of planting material. In frost-free areas Napier fodder can be planted all the year round provided that moisture is available. Where frost is experienced, the young plant should have chance to get well established before the winter.

In order to obtain a maximum of nutritious grazing, the pasture should be divided into a series of paddocks which are used for grazing in rotation. If the climate is suitable the animals will then always be grazing on grass with a high protein content. Newly established Napier fodder should be grazed with care until it has obtained a good root-hold.

In general, it is best to graze Napier fodder when it is between one and two feet high, i.e. grazing of a paddock should commence when the plants are approximately 2 feet high and they should not be grazed off shorter than about one foot from the base. Overgrazing is as harmful to this grass as to most pastures.

The occasional cultivation referred to above is best given with an arch cultivator, which can penetrate deeply and thoroughly aerate the soil.

Apart from Napier fodder, other grasses, such as *Paspalum Virgatum* and *Dilatatum*, have been planted at Cedara in rows sufficiently wide for cultivation, the object also being to increase the available nitrogen through cultivation.

Grazing trials are already being carried out, but it is still too early to draw conclusions.

It is quite possible that these new methods of establishing and managing pastures may prove so successful that they could be adopted to advantage even when there is no danger of any shortage of supplies of nitrogenous fertilizers.

[*Note.*—A shortage of mineral nitrogenous fertilizers would have little effect upon pasture management in Kenya at the present stage of development, as such fertilizers are used to a negligible extent. Further, in the light of experience so far gained, it is doubtful whether the effect of mineral nitrogen under the climatic conditions of this country can be compared, from an economic standpoint, with its effect upon pasture in temperate regions. The main interest in this article to the Kenya farmer lies in the suggested management of Napier grass as pasturage, in addition to its widely recognized use as a "soiling" crop. The grass is already used to a considerable extent for pasture purposes, but the application of the method of soil cultivation outlined may well enhance the nutritive value of the pasture and, at the same time, prolong the productive life of the crop. At least one dairy farmer in the Machakos district of Kenya has, for some years, employed a closely similar method of management with marked success. The rows are set wide apart and inter-cultivation is carried out periodically.—D.C.E.]

BUTTERFAT INSTEAD OF BUTTER FOR EXPORT

The newest idea in saving export shipping space is what is called the re-separation of butter, and the New Zealand Dairy Research Institute has been experimenting successfully with this new technical process. In this re-separation the butter is dissolved to liquid by steam and then run through an ordinary cream separator, which extracts the water, casein, and other substances, leaving only the pure fat. This fat can then be packed in tins and shipped abroad without refrigeration. The extraction of the water and other things also reduces the weight of the product by about 18 per cent. This fat, which can be sent by ordinary cargo ships, can not only be turned into normal butter very easily, but can also be used in the making of margarine. That means, of course, that in its use in making up butter substitutes the dairy industry is not left out entirely.

WATTLE SILVICULTURE

Extracted from "Mining Timber in South Africa with Special Reference to Wattle Silviculture," by R. P. Stephens; The Journal of the South African Forestry Association, *No.* 4, *pp.* 65-66, 1940

Radical changes in wattle silviculture have taken place since 1928, when Craib started his researches upon plantation establishment and management. At this date mature plantations outside the eastern Cape Province rarely carried less than 800 to 1,000 trees per acre. Craib was the first technical silviculturist to make a critical examination of the methods employed by private growers and companies in Natal. As a result of his work it is now extremely rare to find mature areas carrying as many as 800 trees per acre; the average now is about 500, with plantations of several of the larger private growers carrying considerably less than this. As a result of the stress laid by Craib on spacing and grass control in early life (first year) so as to avoid crown reduction because of competition, it was found safer to thin to 400 trees per acre in the first year rather than to 800 in the third year as was done previously. In addition to the greatly improved weed control secured under this new system, every indication was given at an early stage that yields would be higher and bark quality improved.

There is now no responsble body of opinion amongst growers which fails to support Craib's recommendation that vigorous stands should be thinned down to 400 trees per acre in the first year. It was not necessary to secure and publish statistically valid data to support these recommendations for the improvements resulting from them were obvious.

Craib went further, however. He recommended that, where optimum success had been obtained in producing trees with dense crowns, and when drought, pest or grassiness had not interfered with crown vigour, and there was no doubt about an exceptionally high rate of growth being maintained, stands be thinned further to 250 trees per acre at a height of 7 to 10 feet. Otherwise he recommended that stands should be matured at 300 to 400 trees per acre.

The Results in Practice

These final recommendations were based on initial results obtained in a few experimental plots of black and green wattle (*Acacia mollissima* Willd. and *A. decurrens* Willd. respectively), where the number of trees per acre had been reduced to 200 in the first year, and also, of course, on the general results obtained over thousands of acres where thinning to 400 or 500 trees per acre in the first year was being practised. On the basis of these data and examples, the final recommendations appear to have been unnecessarily cautious and overburdened with qualifications. Two hundred vigorous trees per acre at four years of age had given fully stocked stands, with complete grass control from the age of nine months, and crowns with surprisingly small branches for the number of boles per acre. When one considers the advantages attendant on long rotations, and that the new silviculture hoped to extend the average rotation in the industry from eight to twelve years, it will probably be agreed that Craib's recommendataion of spacing to 250 trees only in very special cases was unduly cautious.

Thinning suddenly became so popular, however, that it is not surprising to find that it was not always carried out with due regard to conditions in the plantations themselves. Many of these, which had not been thinned strictly according to the recommended technique, were suddenly thinned at the comparatively advanced ages of two to four years from 600 to 800 trees per acre to 250 to 400. When clear-felled these stands gave smaller bark yields than neighbouring unthinned areas, except where the thinings had been sold. Other stands were thinned to their final espacement of 250 trees per acre when the mean height of the trees were only 3 to 5 feet. The promising initial growth was not sustained, and severe outbreaks of insescts and pests caused serious damage. Growers who suffered these experiences and reverses tend therefore to apply no thinning subsequent to the penultimate thinning to 400 or 500 trees per acre recommended by Craib. The reasons they advance in support of this policy are fourfold:—

(*a*) It makes provision for tree losses due to frost and insects.

(*b*) It controls the development of excessively large branches which cause loss of saleable mining timber due to crookedness.

(*c*) It produces higher yields of bark.

(*d*) It produces smaller average diameters and reduces taper, thereby increasing the proportion of saleable timber, for these growers contend that the mines demand timber in the smaller sizes.

PRINTED BY THE GOVERNMENT PRINTER, NAIROBI, KENYA COLONY